



## PROGRAM UPGRADES

# READING MUHLENBERG CAREER & TECHNOLOGY CENTER

## PROJECT MANUAL

MGA Project #4525A

May 17, 2022





# PROJECT MANUAL

## PROGRAM UPGRADES

**Reading Muhlenberg Career & Technology Center**  
Reading, Berks County, Pennsylvania

### owner

**READING MUHLENBERG CAREER & TECHNOLOGY CENTER**  
2615 Warren Road  
Reading, Pennsylvania 19551

### architect

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955 Berkshire Blvd, Suite 101  
Wyomissing, Pennsylvania 19610-1278  
610-376-4927 P / 610-376-0720 F

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James A. Sarro, AIA, LEED AP+: [JimS@MG-Architects.com](mailto:JimS@MG-Architects.com)

### structural engineers

#### **DiGENOVA ASSOCIATES, INC.**

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### mechanical/electrical engineers

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### civil/site engineers

#### **STACKHOUSE BENSINGER, INC.**

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Sinking Spring, Pennsylvania 19608  
(610) 777-8000

Scott Miller: [smiller@stseinc.com](mailto:smiller@stseinc.com)

**MGA PROJECT NO. 4525A**

**MAY 17, 2022**





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DOCUMENT 000080 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect: Muhlenberg Greene Architects, Ltd.

1. James A. Sarro, AIA, LEED AP BD+C
2. Pennsylvania No. RA408560.
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.



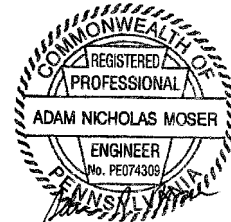
B. Structural Engineer: Di Genova Associates, Inc.

1. Salvatore Di Genova, P.E.
2. Pennsylvania PE042432E
3. Responsible for Division 5 Sections except where indicated as prepared by other design professionals of record.



C. Mechanical Engineer: Consolidated Engineers.

1. Adam N. Moser, P.E., LEED AP
2. Pennsylvania PE074309.
3. Responsible for Divisions 26-28 Sections except where indicated as prepared by other design professionals of record.



D. Electrical Engineer: Consolidated Engineers.

1. Christopher D. VanCampen, P.E., LEED AP
2. Pennsylvania PE075253.
3. Responsible for Divisions 26-28 Sections except where indicated as prepared by other design professionals of record.



END OF SECTION 000107



**DOCUMENT 001116 - INVITATION TO BID**

1.1 PROJECT INFORMATION

- A. Project Identification: **Reading Muhlenberg Career & Technology Center Program Upgrades**
1. Project Location: Reading Muhlenberg Career & Technology Center  
2615 Warren Road  
Reading, Muhlenberg Township, Berks County, PA 19604-1021
  2. Owner: Reading Muhlenberg Career & Technology Center  
2615 Warren Road  
Reading, PA 19604-1021
- B. Owner's Representative: Chad Heffner, Facilities  
Email: [cheffner@rmctc.org](mailto:cheffner@rmctc.org)  
Phone: (610) 921-7300
- C. Architect: Muhlenberg Greene Architects, Ltd.  
955 Berkshire Blvd. Suite 101  
Wyomissing, PA 19610-1278
1. Architect's Representative: James A. Sarro, AIA, LEED AP+  
Email: [JimS@MG-Architects.com](mailto:JimS@MG-Architects.com)  
Phone: (610) 376-4927
- D. The work scheduled at the Reading Muhlenberg Career and Technology Center includes renovations and upgrades to selected areas of the existing building, the new construction of a Welding Classroom building, and site modifications. The interior renovations include combining two classrooms to create one larger classroom to house the 3D Fabrication Program as well as modifications to the existing HVAC systems, upgrades to the lighting and electrical systems, and finishes.
- E. Construction Contract: Bids will be received for the following Work:
1. Multiple Contract Project consisting of the following prime contracts:
    - a. General Construction. (GC)
    - b. Plumbing Construction. (PC)
    - c. HVAC Construction. (HVAC)
    - d. Electrical Construction. (EC)

1.2 DOCUMENTS

- A. In order to bid the project, and receive all pertinent bidding information and addenda, all Prime Contract Bidders **MUST** be registered with, and purchase bidding documents from, Muhlenberg Greene Architects, Ltd. **Documents will be available for purchase on May 17, 2022.**

Documents will be provided to Prime Contract bidders only; complete digital sets of documents only will be issued.

- B. Payment must be received prior to the release of the bid documents; **checks shall be made payable to Muhlenberg Greene Architects, Ltd.** and mailed or delivered to our office at 955 Berkshire Blvd., Suite 101, Wyomissing, PA 19610-1278. No other form of payment is accepted.
- C. Include the following information with your payment:
  - 1. Company name, address, telephone, and fax.
  - 2. Contact name(s) along with email address. You may list up to two contacts in order to receive any addenda via our ShareFile site.
- D. Documents are available in **digital** format and will be released upon receipt of payment in the amount as follows:
  - 1. **Digital** Procurement and Contracting Documents:
    - a. Non-Refundable Fee: **\$75.00**
    - b. Instructions for downloading documents from our ShareFile site will be provided to Prime Contract Bidders only. After downloading documents, Prime Contract Bidder shall sign and return the Acknowledgement Form (provided in the download) confirming receipt of all documentation.

**1.3 BID SUBMITTAL AND OPENING**

- A. Owner will receive sealed bids until the bid time and date at the location indicated below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
  - 1. **Bid Date: June 8, 2022**
  - 2. **Bid Time: 2:00 pm**
  - 3. **Location: Reading Muhlenberg Career & Technology Center  
2615 Warren Road  
Reading, PA 19604**
- B. Submit Bid in an opaque, sealed envelope and addressed to:

Reading Muhlenberg Career & Technology Center  
2615 Warren Road  
Reading, PA 19604

and shall be marked:

**Bid for Proposed: RMCTC – Program Upgrades**

**Name of Contract:** \_\_\_\_\_
- C. Bids will be thereafter publicly opened and read aloud. Bid results will not be official until all information is reviewed, tabulated, and presented to the **Joint School Committee**.

1.4 BID SECURITY

- A. **Bid Security** shall be made **payable** to **Reading Muhlenberg Career & Technology Center**, in the amount of 10 percent (10%) of the Base Bid sum. Security shall be CERTIFIED CHECK, BANK CASHIERS CHECK or AIA A310 BID BOND issued by the Surety licensed to conduct business in the state in which the Project is being constructed. The Owner reserves the right to approve the sufficiency of the required bid security.
- B. The successful bidder's Security will be retained until it has signed the Contract and furnished the required PAYMENT and PERFORMANCE BONDS. The Owner reserves the right to retain the Security of the next three (3) lowest bidders until the lowest Bidder enters into a Contract or until sixty (60) days after bid opening, unless delayed due to required approvals of another governmental agency, in which case bids shall be irrevocable for 120 day. All other Bid Security will be returned as soon as practical. If any Bidder refuses to enter into a Contract, the Owner will retain its Bid Security as liquidated damages, but not as a penalty.
- C. The Bid Security is to be submitted and attached to the BID FORM at the time of submission of Bids.

1.5 PREBID CONFERENCE

- A. A prebid conference for all bidders will be held at Project Site **on Tuesday, May 24, 2022 at 3:00 p.m**; meet at the Main Offices. **Prospective Prime Contract bidders are required to attend.**
  - 1. A primary focus of the conference is to review project requirements, ask questions, and permit Bidders' inspection of the existing conditions.
  - 2. Bidders are to sign-in at the Main Administration Office of the RMCTC.

1.6 MODIFICATION AND WITHDRAWAL

- A. Refer to SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, item 1.12.

1.7 DISQUALIFICATION AND REJECTION OF BIDS

- A. Refer to SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, item 1.13

1.8 AWARD

- A. Refer to SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, item 1.15.

1.9 EXECUTION OF CONTRACT:

- A. Refer to SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, item 1.16.

1.10 TIME OF COMPLETION AND LIQUIDATED DAMAGES

- A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time as noted in item 1.17 of the SUPPLEMENTARY INSTRUCTIONS TO BIDDERS.
- B. Work is subject to liquidated damages as identified in SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.36.

1.11 BIDDER'S QUALIFICATIONS

- A. Bidders must demonstrate a successful track record in the performance of like work and similar projects. Contractor's Qualifications Statement, AIA Document A305-2020, shall be submitted with the Bid Form.
- B. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, a separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder. Refer to SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, ITEM 1.9.

END OF DOCUMENT 001116





# AIA<sup>®</sup> Document A701<sup>™</sup> – 1997

## ***Instructions to Bidders***

for the following PROJECT:  
*(Name and location or address)*

**THE OWNER:**  
*(Name, legal status and address)*

**THE ARCHITECT:**  
*(Name, legal status and address)*

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

### TABLE OF ARTICLES

- 1      **DEFINITIONS**
- 2      **BIDDER'S REPRESENTATIONS**
- 3      **BIDDING DOCUMENTS**
- 4      **BIDDING PROCEDURES**
- 5      **CONSIDERATION OF BIDS**
- 6      **POST-BID INFORMATION**
- 7      **PERFORMANCE BOND AND PAYMENT BOND**
- 8      **FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR**

## ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

## ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 The Bidder by making a Bid represents that:

§ 2.1.1 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

## ARTICLE 3 BIDDING DOCUMENTS

### § 3.1 COPIES

§ 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

§ 3.1.2 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.

§ 3.1.3 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

§ 3.1.4 The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

## § 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

## § 3.3 SUBSTITUTIONS

§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

§ 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

## § 3.4 ADDENDA

§ 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

## ARTICLE 4 BIDDING PROCEDURES

### § 4.1 PREPARATION OF BIDS

§ 4.1.1 Bids shall be submitted on the forms included with the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

#### § 4.2 BID SECURITY

§ 4.2.1 Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

§ 4.2.2 If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

§ 4.2.3 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

#### § 4.3 SUBMISSION OF BIDS

§ 4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

#### § 4.4 MODIFICATION OR WITHDRAWAL OF BID

§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the

signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

## **ARTICLE 5 CONSIDERATION OF BIDS**

### **§ 5.1 OPENING OF BIDS**

At the discretion of the Owner, if stipulated in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids may be made available to Bidders.

### **§ 5.2 REJECTION OF BIDS**

The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

### **§ 5.3 ACCEPTANCE OF BID (AWARD)**

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's own best interests.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

## **ARTICLE 6 POST-BID INFORMATION**

### **§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT**

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

### **§ 6.2 OWNER'S FINANCIAL CAPABILITY**

The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

### **§ 6.3 SUBMITTALS**

§ 6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1)

withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

## **ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND**

### **§ 7.1 BOND REQUIREMENTS**

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

### **§ 7.2 TIME OF DELIVERY AND FORM OF BONDS**

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

## **ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR**

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum.



**SECTION 002114 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS**

**ARCHITECT:**

**Muhlenberg Greene Architects, Ltd.  
955 Berkshire Boulevard, Suite 101  
Wyomissing, PA 19610-1278**

**OWNER:**

**Reading Muhlenberg Career & Technology Center  
2615 Warren Road  
Reading, PA 19604**

**To be considered, Bids must be made in accordance with these Instructions to Bidders.**

**1.1 DOCUMENTS:**

- A. Bona fide Prime Contract Bidders may obtain a complete set of Drawings and Project Manual from the Architect.
- B. Delete in its entirety Article 3.1.1 of the Instructions to Bidders (AIA Document A701) and replace with the following: "Bidders may obtain complete sets of Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid."

**1.2 EXAMINATION:**

- A. Bidders shall CAREFULLY EXAMINE the Documents and the construction Site to obtain first-hand knowledge of existing condition and limitations. FAILURE TO VISIT THE SITE WILL NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR SAME nor will extra payment requests be considered for conditions which could have been determined by examination of the Site and Documents.
- B. Existing Conditions: It is required that all prime Contract Bidders visit the site to become familiar with existing conditions which affect the Work. Subcontract Bidders are encouraged to visit the site also.
  - 1. In addition to the Pre-Bid conference, the School will establish additional dates the building will be available for bidders to visit. All bidders wishing to visit on any of the scheduled days must schedule their visit with Chad Heffner, Facilities, by calling 610-921-7300.
- C. Pre-Bid Conference: A mandatory pre-bid conference will be held as announced in the INVITATION TO BID.

**1.3 QUESTIONS:**

- A. Submit all questions about the Drawings and Project Manual to the Architect, in writing. Replies will be issued to all Prime Bidders of record as Addenda to the Drawings and Specifications and will become part of the Contract. If any item of Work is shown on the Drawings and not specified or mentioned in the Specifications and not shown on the Drawings, the matter should be brought to the attention of the Architect during bidding so an addendum can be issued correcting the omission. If such correction is not made, the Work in question

shall be considered to be required as if it has been specified and shown on the Drawings. The Architect WILL NOT BE RESPONSIBLE FOR ORAL CLARIFICATION. Questions received less than four (4) working days before the bid opening cannot be answered.

1.4 PRE-BID SUBSTITUTIONS:

- A. Bids shall be based on the products or manufacturers specified. This is not intended to eliminate competition from other manufacturers other than those specified. Any bidder who desires to substitute materials or equipment which he believes to be equal to those specified, must submit a written request for substitution to the Architect as specified in Sections 012500 and 016000 at least 7 days prior to the bid due date.

1.5 BASIS OF BID:

- A. The bidder must include any Alternates and Unit Cost items as may be shown on the BID FORM, failure to comply may be cause for rejection of Bid. If Alternates or Unit Prices involve no change in cost or are not applicable (N/A), Bidder shall indicate such on the BID FORM.
- B. No combination of Bids or assignments will be considered unless so noted in the bidding documents.
- C. Failure to acknowledge any addendum or any other item listed on the BID FORM may be cause for rejection of the bid.

1.6 PREPARATION OF BIDS:

- A. Bids shall be made on unaltered BID FORMS. **Fill in all blank spaces and submit two (2) copies.**
- B. Bids shall be signed in ink with name typed below signature. Where Bidder is a corporation, Bids must be signed with the legal name of the corporation followed by the name of the State of incorporation and the legal signature of an officer authorized to bind the corporation to a contract. **ALL UNSIGNED BIDS SHALL BE REJECTED.**
- C. Bidders shall submit, with their bid, two fully executed copies of
  1. Non-Collusive Affidavit.
  2. Contractor's Qualification Statement, AIA Document A305. (Note: Financial Statement need not be submitted with bid but may be required prior to award.)

1.7 QUALITY ASSURANCE:

- A. The Bidder/ Contractor and Subcontractors shall employ only qualified, experienced supervisors and skilled workmen experienced in the type of construction and installations specified for this project.

1.8 BID SECURITY:

- A. Bid Security is required as outlined in the INVITATION TO BID.



**1.9 PERFORMANCE BOND AND PAYMENT BOND:**

- A. Successful Bidders shall be required to furnish and pay for Bonds covering faithful performance of the Contract and payment of all obligations arising there under. Furnish Bonds in the amount of 100% of Bid sum and in such form as the Owner may prescribe and with Surety Company acceptable to the Owner. The bond cost must be included in the bid amount.
- B. The Contractor shall deliver said Bonds to the Owner not later than ten (10) days after issuance of the Intention to Award or Notice to Proceed and prior to executing the Agreement. Failure or neglecting to deliver said Bonds, as specified, shall be considered as having abandoned the Contract and the Bid Security will be retained as liquidated damages.

**1.10 NO-LIEN:**

- A. This is property of a public Owner and, as such, may not be liened. For the protection of sub-contractors and the contractor's suppliers, a payment bond will be required.

**1.11 SUBMITTAL:**

- A. Submit Bid in accordance with the INVITATION TO BID.

**1.12 MODIFICATION AND WITHDRAWAL:**

- A. Bids may not be modified after submittal. Bidders may withdraw Bids at any time up to the scheduled time for opening of bids.
- B. A Bid may not be modified, withdrawn or canceled by the Bidder for sixty (60) days after the opening of the bids and each Bidder so agrees in submitting its Bid, unless the award of the Contract is delayed due to required approvals of other governmental agencies, in which case, Bids shall be irrevocable for one hundred twenty (120) days in compliance with Act 1978-317, approved November 26, 1978.

**1.13 DISQUALIFICATION AND REJECTION OF BIDS:**

- A. The Owner reserves the right to disqualify Bids, before or after opening, upon evidence of collusion with intent to defraud or other illegal practices upon the part of the Bidder.
- B. The Owner has the right to reject bids, which are not responsive, and to not award to any bidder which is deemed to be not responsible.

**1.14 OPENING BIDS:**

- A. Bids will be publicly opened and read aloud as announced in the INVITATION TO BID.

**1.15 AWARD:**

- A. The Contract will be awarded on the basis of the lowest responsive base bid, including full consideration of any Alternates and Unit Prices, as may appear on the Bid Form.
- B. Post Bid Information: Delete entirely Paragraph 6.2 "Owner's Financial Capability". Delete last sentence of sub-paragraph 4.2.1.

1.16 EXECUTION OF CONTRACT:

- A. The Owner reserves the right to accept any Bid, and to reject any or all Bids.
- B. Each Bidder shall be prepared, if so requested by the Owner, to present evidence of his experience, qualifications, and financial ability to carry out the terms of the Contract.
- C. Notwithstanding any delay in the preparation and execution of the formal Contract Agreement, the Contractor shall be prepared and agrees to commence work within five (5) days after notice to proceed is given, or on date stipulated in such order.
- D. The accepted Contractor shall assist and cooperate with the Owner in preparing the formal Contract Agreement, and within five (5) days following its presentation shall execute same and return it to the Owner.

1.17 TIME OF COMPLETION:

- A. The Contractor shall begin the Work on the date of commencement as defined in subparagraph 8.1.2 of the General Conditions or as identified in the Notice to Proceed issued by the Architect and carry the Work forward expeditiously to achieve Substantial Completion of the work in accordance with the project schedule developed for the project.
- B. The Contractor understands and agrees that TIME IS OF THE ESSENCE and that all schedule dates are minimum performance dates. Notwithstanding anything to the contrary contained in the Contract Documents, should the progress of the Project be ahead of scheduled dates, the Contractor agrees to coordinate and complete its Work in accordance with the actual Project progress and the actual pace of the Project without additional compensation. In said case, contractor waives any right to claim that it has been accelerated.
  - 1. The date for Award of Contracts is anticipated on June 13, 2022 with the Notice to Proceed for construction being issued by July 13, 2022. The on-site construction activity scheduled to start the first week of August 2022. The work for the project will be performed in phased activities as indicated in the project documents.
    - a. Submittals, shop drawings, ordering of materials and equipment are to be submitted in a timely manner following the *Notice to Proceed*. Coordination and cooperation of all contractors is required to ensure that products and equipment needed by various contracts shall be available as work progresses to meet the schedule for completion of the project.
  - 2. All Construction Activities at the site are to be coordinated with the School:
    - a. Mobilization to deliver materials, trailers, temporary facilities, etc. to the site is anticipated to begin on the scheduled date for on-site construction activity.
    - b. Construction activities requiring access to the school buildings starts following the last day for students, anticipated to be June 7, 2022.
    - c. **Substantial Completion dates for the phases of work identified on the contract documents for all contracts shall occur as follows:**

**Phase A: No later than May 1, 2023.**

**Phase B: No later than August 14, 2023.**

3. Should the Contractor fail to complete the work in accordance with the Contract Documents, liquidated damages shall be assessed based on the project schedule noted above in these Supplementary Instructions and as further defined in Section 013200. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.36 for LIQUIDATED DAMAGES.

**1.18 GOVERNING LAWS AND REGULATIONS:**

- A. The Bidder's attention is directed to the fact that all applicable Federal and State laws, municipal ordinances and codes, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and the following paragraphs B through L are deemed to be included in the Contract the same as though herein written in full.
- B. FEDERAL OCCUPATIONAL SAFETY & HEALTH ACT OF 1970 (O.S.H.A.):
  1. The Contractor is required to promptly perform all reporting and recording as required by said Act.
- C. PENNSYLVANIA ACT 287 - UTILITIES PROTECTION:
  1. The Contractor will be responsible for complying with Pennsylvania Act 287 of 1974, as amended, commonly known as the "CALL BEFORE YOU DIG ACT". Excavation or digging Contractors may learn the utilities and authority Owners by calling 1-800-242-1776 statewide prior to work. One call locates utility lines and the utilities are notified.
- D. COMPLIANCE WITH HUMAN RELATIONS ACT:
  1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.8.
- E. PREVAILING WAGE REQUIREMENTS:
  1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.6
- F. DISCRIMINATION PROHIBITED AND COMPLIANCE WITH ADA:
  1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.7.
- G. COMPLIANCE WITH STEEL PRODUCTS PROCUREMENT ACT:
  1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.11.
- H. STANDARD OF QUALITY:
  1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.10.

- I. PROHIBITION OF CASH ALLOWANCES:
  - 1. Cash allowances are not to be included in the bid specification.
  
- J. RIGHT TO KNOW ACT:
  - 1. Contractor shall comply with all terms and conditions of the Pennsylvania Right to Know Act, Act No, 159 of 1984, 35 P.S. Paragraph 7301 et. Seq., and its implementing regulations.
  
- K. COMPETENT WORKMEN:
  - 1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.53, paragraph 13.12.
  
- L. BACKGROUND CHECK REQUIREMENT (ACTS 34 AND 151)
  - 1. Refer to SUPPLEMENTARY CONDITIONS OF THE CONTRACT, item 1.12, paragraph 3.4.7.

END OF SECTION 002114

**SECTION 002215 - BID FORM: ALL PRIME CONTRACTS**

Prime Contract Bidding: *CHECK PRIME CONTRACT*

- CONTRACT 1: GENERAL CONSTRUCTION
- CONTRACT 2: PLUMBING CONSTRUCTION
- CONTRACT 3: HVAC CONSTRUCTION
- CONTRACT 4: ELECTRICAL CONSTRUCTION

Name of Contractor \_\_\_\_\_

Contact Name and Title \_\_\_\_\_

Contact's Telephone Number \_\_\_\_\_

Owner's Name and Title \_\_\_\_\_

Owner's Telephone Number \_\_\_\_\_

In conformity with the Plans and Specifications as prepared by Muhlenberg Greene Architects, Ltd., 955 Berkshire Blvd, Suite 101, Wyomissing, PA 19610, after an examination of the site and the Bidding and Contract Documents, the undersigned submits this proposal and enclosed herewith a bond in an amount of not less than ten percent (10%) of the total of the hereinafter stated Base Bid, made payable to or indemnifying the Reading Muhlenberg Career & Technology Center, 2615 Warren Road, Reading, PA 19605, which it is understood will be held by the Owner, as security as provided in the Instructions to Bidders, if this proposal or any part thereof is accepted by the Owner, and the undersigned shall fail to furnish approved bonds and execute the Agreement within ten (10) days from the date of issuance of the award. Should the Owner fail to make an award on this project through no fault or failure on the part of the Bidder, then the Owner shall return said bid security.

It is hereby certified that the undersigned is the only person(s) interested in this proposal as principal, and that the proposal is made without collusion with any person, firm or corporation. The Bidder submits herewith, as such, a Non-Collusion Affidavit in accordance with the provisions of the Pennsylvania Anti-Bid-Rigging Act of October 28, 1983.

Bidder hereby agrees to execute the Agreement and furnish surety company bonds in the amount of one hundred percent (100%) of the Contract Price for the Performance Bond and Labor and Material Payment Bond, within ten (10) days after mailing by the Owner of notice of award, and to begin work with ten (10) days after date of Notice to Proceed.

Bidder guarantees that, if awarded contract, he will furnish and deliver all materials, tools, equipment, tests transportation, secure all permits and licenses, do and perform all labor, supervision and all means of construction, pay all fees and do all incidental work, and to execute, construct and finish, in an expeditious, substantial and workmanlike manner, in accordance with the plans and specifications, to the complete satisfaction and acceptance of the Owner, for the Work of this Contract.

It is understood that the Owner, reserves the right to reject any or all proposals, or part thereof, or items therein and to waive technicalities required for the best interest of the Owner. It is further understood that competency and responsibility of bidders will receive consideration before the award of the contract. A certified copy of the Contractor's Qualification Statement, AIA Document A-305 must be submitted with the Bid Form.

Contractor/Bidder acknowledges that time is of essence. Contractor/Bidder acknowledges that with the submission of this bid the schedule for project, identified in the Supplementary Instructions to Bidders, will be maintained.

The bidder agrees that he will not assign his bid or any of his rights or interests thereunder without the written consent of the Owner. In the event of a discrepancy between the verbiage (words) and numbers entered here below, the verbiage shall govern.

**Bid Withdrawal**

This proposal is submitted with the definite understanding that it will not be withdrawn for a period of sixty (60) days after Bids are due, or any authorized postponement thereof.

**THE BID, as called for, is submitted as follows:**

**A. BASE BIDS:**

1. For all \_\_\_\_\_ **Construction Work**, as shown and specified in the  
*Insert prime contract*

Contract Documents for the lump sum of:

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

**B. BID INCLUSIONS (See Section 012210 for full description)**

The undersigned proposes the following bid inclusions for work more fully described in Specification Section 012210. **Applicable Prime Construction** Bidder shall provide bid inclusions for all items listed on Bid Form.

**General Construction: Contract No. 1**

- Bid Inclusion #GC-01: \_\_\_\_\_ (250 Hours Skilled Labor)  
Bid Inclusion #GC-02: \_\_\_\_\_ (50 Painters Hours and 5 Gallons of Paint)

**Plumbing Construction: Contract No. 2**

- Bid Inclusion #PC-01 ----- (100 Linear feet of 2-inch, schedule 40, steel natural gas piping)  
Bid Inclusion #PC-02 \_\_\_\_\_ (100 Linear feet of 2-inch, Type L, copper piping)  
Bid Inclusion #PC-03 \_\_\_\_\_ (200 Hours Journeyman Plumber Time)

**HVAC Construction: Contract No. 3**

- Bid Inclusion #HC-01 \_\_\_\_\_ (500 pounds of galvanized metal duct work)  
Bid Inclusion #HC-02 \_\_\_\_\_ (3 additional thermostat devices)  
Bid Inclusion #HC-03 \_\_\_\_\_ (100 hours of Journeyman HVAC Time)

**Electrical Construction: Contract No. 4**

Bid Inclusion #EC-01 \_\_\_\_\_ (10 Additional Duplex receptacles and 20A circuit)  
Bid Inclusion #EC-02 \_\_\_\_\_ (5 Additional Data Outlets)  
Bid Inclusion #EC-03 \_\_\_\_\_ (5 Additional Ceiling Mounted Fire Alarm Audio/Visual Appliances)  
Bid Inclusion #EC-04 \_\_\_\_\_ (5 Additional 60A, 3-Phase receptacles and 60A, 3-Phase circuit)  
Bid Inclusion #EC-05 \_\_\_\_\_ (200 hours of Journeyman Electricians time)

**C. UNIT PRICES (See Section 012200 for full description)**

The undersigned proposes the following unit prices for work more fully described in Specification Section 012200. **Applicable Prime Construction** Bidder shall provide unit prices for all items listed on Bid Form.

**General Construction: Contract 1**

Unit Price #GC-01 \_\_\_\_\_/sq.ft. (Cutting and Patching of Concrete Slabs-on-Grade)  
Unit Price #GC-02 \_\_\_\_\_/cu.yd. (Trench Excavation)  
Unit Price #GC-03 \_\_\_\_\_/cu.yd. (Trench Rock Excavation)  
Unit Price #GC-04 \_\_\_\_\_/cu.yd. (Bulk Excavation)  
Unit Price #GC-05 \_\_\_\_\_/cu.yd. (Bulk Fill)  
Unit Price #GC-06 \_\_\_\_\_/sq.ft. (Reconstruction / Repair of existing asphalt paving)  
Unit Price #GC-07 \_\_\_\_\_/ lump sum (Steel Beams in lieu of Steel Joists)

**Plumbing Construction: Contract 2**

Unit Price #PC-01 \_\_\_\_\_/10 lin.ft. (Steel Natural Gas Piping)  
Unit Price #PC-02 \_\_\_\_\_/10 lin.ft. (Domestic Cold-Water Piping)

**HVAC Construction: Contract 3**

Unit Price #HVAC-01 \_\_\_\_\_/100 lb. (Galvanized Sheet Metal Ductwork w/ Acoustical Liner)  
Unit Price #HVAC-02 \_\_\_\_\_/device (Wall-Mounted DDC Temperature Sensor)

**Electrical Construction: Contract 4**

Unit Price #EC-01 \_\_\_\_\_/receptacle (Additional Duplex Receptacle & 20A Circuit)  
Unit Price #EC-02 \_\_\_\_\_/data jack (Additional Data Jacks)  
Unit Price #EC-03 \_\_\_\_\_/fire alarm audio/visual appliance (Ceiling Mounted Fire Alarm Visual Appliances)  
Unit Price #EC-04 \_\_\_\_\_/receptacle (Additional Twist Lock 60A, Receptacle & 60A, 3-Phase Circuit)

**D. ATTACHMENTS:**

The following documents, having been executed by the Undersigned, are attached and are made a condition of this Bid:

1. Non-Collusion Affidavit.
2. Contractor's Qualification Statement.

**E. ACCEPTANCE OF ADDENDA:**

In submitting this proposal, I have received and included in this bid the instructions and information contained in the following Addenda:

<u>Addendum No.</u>	<u>Dated</u>
_____	_____
_____	_____
_____	_____
_____	_____

**F. BID SECURITY:**

The Bid Security attached in the sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ )

is to become the property of the Owner, in the event the Contract is not executed within the time set forth in the Supplemental Instructions to Bidders, as liquidated damages for the delay and additional expenses to the Owner caused thereby.

**G. SIGNATURES:**

The Undersigned here certifies that this Proposal is genuine and not a sham, collusive or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein named; and that the Undersigned has not, directly or indirectly, inducted or solicited any bidder to submit a sham bid, or any other person, firm or corporation from bidding, and that the Undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.



Respectfully submitted:

\* \_\_\_\_\_  
(Company)

\_\_\_\_\_  
(Business Address)

(SEAL)

By: \_\_\_\_\_  
(Signature)

Name/Title: \_\_\_\_\_  
(Typed Name)

Telephone Number: \_\_\_\_\_

Individual to Contact for this Contract:

\_\_\_\_\_  
(Typed Name)

Email: \_\_\_\_\_

Attest:

By: \_\_\_\_\_  
(Title)

\*When the bidder is a corporation: The \_\_\_\_\_ is a  
Corporation organized and existing under the laws of \_\_\_\_\_

END OF BID FORM



 **AIA** Document A310™ – 2010**Bid Bond****CONTRACTOR:***(Name, legal status and address)***SURETY:***(Name, legal status and principal place of business)***OWNER:***(Name, legal status and address)***BOND AMOUNT: \$****PROJECT:***(Name, location or address, and Project number, if any)*

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

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

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

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

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

Signed and sealed this day of ,

\_\_\_\_\_  
*(Contractor as Principal)*

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

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

\_\_\_\_\_  
*(Title)*

\_\_\_\_\_  
*(Surety)*

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

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

\_\_\_\_\_  
*(Title)*



Init.

User Notes:

**004510 AFFIDAVIT - INSTRUCTIONS FOR NON-COLLUSIVE AFFIDAVIT**

1. This Non-Collusive Affidavit is material to any contract awarded pursuant to this bid. According to the Pennsylvania Antibid-Rigging Act, 73 P.S., 1611 et. seq., governmental agencies may require Non-Collusive Affidavits to be submitted together with bids.
2. This Non-Collusive Affidavit must be executed by the members, officer, or employee of the bidder who makes the final decision 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 this 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 any 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.

**NON-COLLUSIVE**

**AFFIDAVIT**

**Reading Muhlenberg Career and Technology Center  
Program Upgrades**

State of \_\_\_\_\_ )  
County of \_\_\_\_\_ ) SS

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

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 bidder.

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

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

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

(5) \_\_\_\_\_, its affiliates,  
(Name of my firm)

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

\_\_\_\_\_  
\_\_\_\_\_

A statement that a person or firm has been so convicted or found liable does not prohibit the Reading Muhlenberg Career and Technology Center from accepting a bid from or awarding a contract to such bidder, but may be a ground for consideration by the reading Muhlenberg Career and Technology Center on the question whether the District should decline to award a contract to the bidder on the basis of lack of responsibility.

I state that \_\_\_\_\_ understands  
(Name of my firm)

and acknowledges that the above representations are material and important, and will be relied on by Reading Muhlenberg Career and Technology Center in awarding the contract 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 Reading Muhlenberg Career and Technology Center of the true facts relating to the submission of bids for this contract.

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

Title: \_\_\_\_\_

\_\_\_\_\_  
Firm

SWORN TO AND SUBSCRIBED BEFORE ME  
THIS \_\_\_\_\_  
DAY OF \_\_\_\_\_, 2021.

NOTARY PUBLIC

MY COMMISSION EXPIRES \_\_\_\_\_.







# AIA Document A305™ – 2020

## Contractor's Qualification Statement

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

**SUBMITTED BY:**

*(Organization name and address.)*

**SUBMITTED TO:**

*(Organization name and address.)*

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

### TYPE OF WORK TYPICALLY PERFORMED

*(Indicate the type of work your organization typically performs, such as general contracting, construction manager as constructor services, HVAC contracting, electrical contracting, plumbing contracting, or other.)*

### THIS CONTRACTOR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING:

*(Check all that apply.)*

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

### CONTRACTOR CERTIFICATION

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

\_\_\_\_\_  
**Organization's Authorized Representative Signature      Date**

\_\_\_\_\_  
**Printed Name and Title**

### NOTARY

State of:

County of:

Signed and sworn to before me this      day of

\_\_\_\_\_  
**Notary Signature**

**My commission expires:**



# AIA Document A305™ – 2020 Exhibit A

## General Information

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

### § A.1 ORGANIZATION

#### § A.1.1 Name and Location

§ A.1.1.1 Identify the full legal name of your organization.

This document has important legal consequences.

Consultation with an attorney is encouraged with respect to its completion or modification.

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

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

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

#### § A.1.2 Legal Status

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

- .1 If your organization is a corporation, identify the state in which it is incorporated, the date of incorporation, and its four highest-ranking corporate officers and their titles, as applicable.
- .2 If your organization is a partnership, identify its partners and its date of organization.
- .3 If your organization is individually owned, identify its owner and date of organization.
- .4 If the form of your organization is other than those listed above, describe it and identify its individual leaders:

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

**§ A.1.3 Other Information**

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

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

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

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

**§ A.2 EXPERIENCE**

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

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

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

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

**§ A.3 CAPABILITIES**

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

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

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

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

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

**§ A.4 REFERENCES**

**§ A.4.1** Identify three client references:

*(Insert name, organization, and contact information)*

**§ A.4.2** Identify three architect references:

*(Insert name, organization, and contact information)*

**§ A.4.3** Identify one bank reference:

*(Insert name, organization, and contact information)*

**§ A.4.4** Identify three subcontractor or other trade references:

*(Insert name, organization, and contact information)*

Sample



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# Document A305™ – 2020 Exhibit B

## Financial and Performance Information

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

### § B.1 FINANCIAL

§ B.1.1 Federal tax identification number:

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

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

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

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

### § B.2 DISPUTES AND DISCIPLINARY ACTIONS

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

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

- .1 failed to complete work awarded to it?
- .2 been terminated for any reason except for an owners’ convenience?
- .3 had any judgments, settlements, or awards pertaining to a construction project in which your organization was responsible for more than \$75,000?

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

**§ B.2.3** In the last five years, has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management; or any of the individuals listed in Exhibit A Section 1.2:

*(If the answer to any of the questions below is yes, provide an explanation.)*

- .1 been convicted of, or indicted for, a business-related crime?
- .2 had any business or professional license subjected to disciplinary action?
- .3 been penalized or fined by a state or federal environmental agency?

Sample



# AIA Document A305™ – 2020 Exhibit C

## Project Specific Information

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

**PROJECT:**

*(Name and location or address.)*

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

**CONTRACTOR’S PROJECT OFFICE:**

*(Identify the office out of which the contractor proposes to perform the work for the Project.)*

**TYPE OF WORK SOUGHT**

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

**CONFLICT OF INTEREST**

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

**§ C.1 PERFORMANCE OF THE WORK**

**§ C.1.1** When was the Contractor’s Project Office established?

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

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

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

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

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

## **§ C.2 EXPERIENCE RELATED TO THE PROJECT**

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

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

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

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

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

## **§ C.3 SAFETY PROGRAM AND RECORD**

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

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

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

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

## **§ C.4 INSURANCE**

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

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

**§ C.4.3** Does your commercial general liability policy contain any exclusions or restrictions of coverage that are prohibited in AIA Document A101-2017, Exhibit A, Insurance A.3.2.2.3? If so, identify.



**§ C.5 SURETY**

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

**§ C.5.2** Surety company name:

**§ C.5.3** Surety agent name and contact information:

**§ C.5.4** Total bonding capacity:

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

Sample



**AIA**<sup>®</sup>

# Document A305™ – 2020 Exhibit D

## Contractor's Past Project Experience

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



**AIA**<sup>®</sup>

# Document A305™ – 2020 Exhibit E

## Contractor's Past Project Experience, Continued

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





**AIA**<sup>®</sup>

# Document A101<sup>™</sup> – 2017

## **Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum**

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

**BETWEEN** the Owner:  
*(Name, legal status, address and other information)*

and the Contractor:  
*(Name, legal status, address and other information)*

for the following Project:  
*(Name, location and detailed description)*

The Architect:  
*(Name, legal status, address and other information)*

The Owner and Contractor agree as follows.

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

The parties should complete A101<sup>™</sup>-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement.

AIA Document A201<sup>™</sup>-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

Init.

/

## TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS

### EXHIBIT A INSURANCE AND BONDS

#### ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

#### ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

#### ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

*(Check one of the following boxes.)*

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:  
*(Insert a date or a means to determine the date of commencement of the Work.)*

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

#### § 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

*(Check one of the following boxes and complete the necessary information.)*



[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
-----------------	-----------------------------

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

#### ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be (\$ ), subject to additions and deductions as provided in the Contract Documents.

#### § 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
------	-------

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

*(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)*

Item	Price	Conditions for Acceptance
------	-------	---------------------------

§ 4.3 Allowances, if any, included in the Contract Sum:

*(Identify each allowance.)*

Item	Price
------	-------

§ 4.4 Unit prices, if any:

*(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.5 Liquidated damages, if any:

*(Insert terms and conditions for liquidated damages, if any.)*

§ 4.6 Other:

*(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*



## ARTICLE 5 PAYMENTS

### § 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the 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 below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the     day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the     day of the     month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than     (     ) days after the Architect receives the Application for Payment.

*(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

### § 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

*(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)*



§ 5.1.7.1.1 The following items are not subject to retainage:  
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:  
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:  
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

## § 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

## § 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

%

## ARTICLE 6 DISPUTE RESOLUTION

### § 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.  
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

**§ 6.2 Binding Dispute Resolution**

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

*(Check the appropriate box.)*

- Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- Litigation in a court of competent jurisdiction
- Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

**ARTICLE 7 TERMINATION OR SUSPENSION**

**§ 7.1** The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

**§ 7.1.1** If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

*(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)*

**§ 7.2** The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

**ARTICLE 8 MISCELLANEOUS PROVISIONS**

**§ 8.1** Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

**§ 8.2** The Owner’s representative:

*(Name, address, email address, and other information)*

**§ 8.3** The Contractor’s representative:

*(Name, address, email address, and other information)*



§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

*(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)*

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:  
*(Insert the date of the E203-2013 incorporated into this Agreement.)*

.5 Drawings

Number	Title	Date
--------	-------	------

.6 Specifications

Section	Title	Date	Pages
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.7 Addenda, if any:

Number	Date	Pages
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Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:

*(Check all boxes that apply and include appropriate information identifying the exhibit where required.)*

AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:  
*(Insert the date of the E204-2017 incorporated into this Agreement.)*

The Sustainability Plan:

Title	Date	Pages
-------	------	-------

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
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.9 Other documents, if any, listed below:

*(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)*

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

\_\_\_\_\_  
OWNER (Signature)

\_\_\_\_\_  
CONTRACTOR (Signature)

\_\_\_\_\_  
(Printed name and title)

\_\_\_\_\_  
(Printed name and title)

Init.





**AIA**<sup>®</sup>

# Document A201™ – 2017

## General Conditions of the Contract for Construction

for the following PROJECT:  
*(Name and location or address)*

**THE OWNER:**  
*(Name, legal status and address)*

**THE ARCHITECT:**  
*(Name, legal status and address)*

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

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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## ARTICLE 1 GENERAL PROVISIONS

### § 1.1 Basic Definitions

#### § 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, 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 the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

#### § 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the 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 and by Separate Contractors.

#### § 1.1.5 The Drawings

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

#### § 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### § 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

#### § 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

### § 1.2 Correlation and Intent of the Contract Documents

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

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

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

### § 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### § 1.4 Interpretation

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

### § 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

### § 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

### § 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

### § 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set

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forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

## ARTICLE 2 OWNER

### § 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

### § 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

### § 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.



§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

#### § 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

#### § 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

### ARTICLE 3 CONTRACTOR

#### § 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

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



### § 3.2 Review of Contract Documents and Field Conditions by Contractor

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

### § 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

### § 3.4 Labor and Materials

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



§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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

### § 3.5 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 the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### § 3.6 Taxes

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

### § 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### § 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately

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suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

### § 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

### § 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

### § 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

**§ 3.11 Documents and Samples at the Site**

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

**§ 3.12 Shop Drawings, Product Data and Samples**

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

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

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

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, 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.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

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§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

### § 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

### § 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its 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 and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

### § 3.16 Access to Work

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



### § 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### § 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), but only to the extent caused by the 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 that would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

## ARTICLE 4 ARCHITECT

### § 4.1 General

**§ 4.1.1** The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

**§ 4.1.2** 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.

### § 4.2 Administration of the Contract

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

**§ 4.2.2** The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not



have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

#### § 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's 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 has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the 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, suppliers, their agents or employees, or other persons or entities 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 in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. 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 Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; 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 pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 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 Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 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 in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 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 rendered in good faith.

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§ 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.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## ARTICLE 5 SUBCONTRACTORS

### § 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the 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, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner 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. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

### § 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner 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 that may be at variance with the Contract Documents. Subcontractors will

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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 Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

### 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 term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When 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 any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule 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 or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has 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 notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the

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Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

### § 6.3 Owner's Right to Clean Up

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, the Owner may clean up and the Architect will allocate the cost among those responsible.

## ARTICLE 7 CHANGES IN THE WORK

### § 7.1 General

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

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, 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. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

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

### § 7.3 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 prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

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

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

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

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- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the 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.

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

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

#### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor

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change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

## **ARTICLE 8 TIME**

### **§ 8.1 Definitions**

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

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

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

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

### **§ 8.2 Progress and Completion**

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

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

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

### **§ 8.3 Delays and Extensions of Time**

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended 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 Article 15.

§ 8.3.3 This Section 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.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### **§ 9.2 Schedule of Values**

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

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### § 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 prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 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 the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

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

### § 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 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 evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. 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 correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. 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 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 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 Section 9.4.2 cannot

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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 Section 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 withhold a Certificate for Payment or, because of subsequently discovered evidence, 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 for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

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

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

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

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

## § 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 pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The 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 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

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

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§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

### § 9.7 Failure of Payment

If the 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 binding dispute resolution, then the Contractor may, upon seven additional days' 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 shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

### § 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that 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 prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.



### § 9.9 Partial Occupancy or Use

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

§ 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 the Contractor's 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. 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 on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 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, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the 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, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.



- § 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from
- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
  - .2 failure of the Work to comply with the requirements of the Contract Documents;
  - .3 terms of special warranties required by the Contract Documents; or
  - .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

### § 10.1 Safety Precautions and Programs

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

### § 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, a Subcontractor, or a Sub-subcontractor; 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 comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

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

§ 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 Sections 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 Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner 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 Section 3.18.

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

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

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### § 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

### § 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, 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 or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

### § 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

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## ARTICLE 11 INSURANCE AND BONDS

### § 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

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

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

### § 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 **Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.



### § 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

### § 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

### § 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

## 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 requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine 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, the Contractor shall be entitled to an equitable adjustment to

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the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

## § 12.2 Correction of Work

### § 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

### § 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work 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 completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

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

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

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

## § 12.3 Acceptance of Nonconforming Work

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

## ARTICLE 13 MISCELLANEOUS PROVISIONS

### § 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.



### § 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

### § 13.3 Rights and Remedies

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

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

### § 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the 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 that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

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

§ 13.4.5 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.

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

### § 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties 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.



## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

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

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

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

### § 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

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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 Initial Decision Maker, 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 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

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

#### § 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

### ARTICLE 15 CLAIMS AND DISPUTES

#### § 15.1 Claims

##### § 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

##### § 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

##### § 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.



§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

**§ 15.1.4 Continuing Contract Performance**

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

**§ 15.1.5 Claims for Additional Cost**

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

**§ 15.1.6 Claims for Additional Time**

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

**§ 15.1.7 Waiver of Claims for Consequential Damages**

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

**§ 15.2 Initial Decision**

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the

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Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

### § 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

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§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

#### § 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing 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.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

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

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

#### § 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.





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**SECTION 007300 - SUPPLEMENTARY CONDITIONS OF THE CONTRACT**

THE FOLLOWING SUPPLEMENTS MODIFY, CHANGE, DELETE FROM, OR ADD TO THE "**GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**", **AIA DOCUMENT A201-2017**. WHERE ANY ARTICLE OF THE GENERAL CONDITIONS IS MODIFIED, OR ANY PARAGRAPH, SUBPARAGRAPH, OR CLAUSE THEREOF IS MODIFIED OR DELETED BY THESE SUPPLEMENTARY CONDITIONS, THE UNALTERED PROVISIONS OF THAT ARTICLE, PARAGRAPH, SUBPARAGRAPH, OR CLAUSE SHALL REMAIN IN EFFECT.

**1.1 Add the following Subparagraph 1.1.9, Miscellaneous Definitions:**

**1.1.9.1** The terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Architect" and similar phrases. However, no implied meaning shall be interpreted to extend the Architects' responsibility into the Contractor's area of construction supervision.

**1.1.9.2** The term "approved" where used in conjunction with the Architect's action on the Contractor's submittals applications and requests is limited to the responsibilities and duties of the Architect stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract Document requirements, unless otherwise provided in the Contract Documents.

**1.1.9.3** The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation and similar operations." It is acknowledged that Owner will supply certain materials but Contractor shall be responsible for its delivery.

**1.1.9.4** The term "install" is used to describe operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations.

**1.1.9.5** The term "provide" means to furnish and install complete and ready for the intended use.

**1.1.9.6** The term "an installer" is an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor for performance of a particular construction activity, including installation, erection, application and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

The term "experienced" when used with the term "installer" means having a minimum of five (5) previous projects similar in size and scope to this Project and familiar with the precautions required, and has complied with requirements of the authority having jurisdiction."

**1.2 Add the following Subparagraph 1.2.4:**

**1.2.4** In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

- A. The Agreement between Owner and Contractor, AIA Document A101-2017 edition.
- B. Addenda, with those of later date having precedence over those of an earlier date.
- C. The Supplementary Conditions of the Contract.
- D. The General Conditions of the Contract for Construction, AIA Document A201-2017 edition.
- E. Drawings and Specifications.
  1. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by Addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect's interpretation."

**1.3 Add the following Subparagraph 1.2.5 as follows:**

"1.2.5 Notations which apply to one of a number of similar situations, materials, or processes shall be deemed to apply to all except where indicated to the contrary. All manufactured material and equipment shall be installed and used in accordance with the manufacturer's instructions unless specifically otherwise directed in the Contract Documents."

**1.4 Add the following Subparagraph 1.7.1 as follows:**

"1.7.1 The Architect will make available to the Contractor, upon request, Digital Data files of selected contract drawings for the Contractor's purposes solely and exclusively to perform services or construction for the project. The Contractor shall request Digital Data files of specific drawings using the Electronic Media Release Form provided by the Architect. Upon receipt of the Release Form, Digital Data files of the requested drawings will be forwarded to the Contractor via a compact disc or through an "FTP type" website established for the project. Along with the Electronic Media Release Form, the Contractor shall submit a check, made payable to Muhlenberg Greene Architects, Ltd., in the amount of \$100.00 to cover the cost of technician's time for preparing document files, preparation of discs, shipping, etc."

**1.5 Add the following Subparagraph 1.7.2 as follows:**

"1.7.2 In the event the Contractor requests and receives Digital Data or similar electronic files of project documents for use in the execution of the Work of this project, it is with the understanding that the Digital Data or electronic files provided are for informational purposes only and may not necessarily represent the final and/or complete design of the project and its systems. The Contractor shall not rely on the accuracy of the information provided, but shall be responsible to verify all information and actual project conditions.

Neither the Owner nor Architect assumes responsibility for the information contained on the Digital Data or electronic files or the subsequent use of the information. The Owner and Architect caution any user of the Digital Data or electronic files that subsequent changes may have been made to the Project and/or Contract Documents which may not be reflected on the electronic files. Only final stamped drawings represent an accurate record of the Architects' design.

To the fullest extent permitted by law, the Contractor shall indemnify and defend the Owner, Architect and their respective officers, directors, representatives, insurers, agents, employees and assigns from and against all claims, actions, damages, losses and costs arising from or related to the Contractor's request for and use of Digital Data or electronic project document files, including, but not limited to, any errors, omissions, anomalies, or variances contained therein."

**1.6 Delete Paragraph 2.2 and associated subparagraphs 2.2.1, 2.2.2, 2.2.3, 2.2.4.**

**1.7 Change Paragraph 2.4 as follows:**

In the third line after the words, "the Owner may" insert the following: "- in addition to all other remedies available at law or hereunder -".

**1.8 Change Paragraph 2.5 as follows:**

In the first sentence:

- Change "ten-day period" to read "5-day period."
- Change the words, "...without prejudice to other remedies the Owner may have, correct such deficiencies." to read: "...without prejudice to other remedies the Owner may have, *immediately* correct such default or neglect."



**1.9 Delete Subparagraph 3.2.1 and replace with the following:**

**“3.2.1** The Contractor warrants that it has carefully studied and reviewed the Contract Documents and has reported any errors, inconsistencies or omissions to the Architect. The Contractor hereby acknowledges and declares that to Contractor’s knowledge the Contract Documents are full and complete, are sufficient to have enabled the Contractor to determine the cost of the Work and fulfill all of the Contractor’s obligations under the Contract Documents. The Contractor shall immediately report any error, inconsistency or omission it encounters to the Architect for resolutions. If the Contractor performs any construction activity knowing or having reason to know that it involves an error, inconsistency or omission, the Contractor shall bear the cost of construction.”

**1.10 Change Subparagraph 3.3.2 as follows:**

In the second line after "agents and employees," insert "Suppliers and their agents and employees,"

**1.11 Add the following Subparagraphs 3.3.4 through 3.3.09:**

**“3.3.4** The Contractor shall perform its Work in accordance with the Contract Documents and in a professional, businesslike and workmanlike manner. Among other things, at completion of the Work, the Contractor shall thoroughly clean the site and remove from the site all tools, equipment, obstructions and debris resulting from the Work.

**3.3.5** The Contractor shall abide by all federal, state and local legal requirements applicable to this project, including requirements imposed by statute, regulation, code, ordinance, administrative rule or by order of any court or administrative agency. This includes, but is not limited to, requirements governing health, safety, labor and environmental protection. Among other things, the Contractor shall submit an MSDS form (or other required form) and proper labeling to the Architect in advance of each chemical being used.

**3.3.6** The Contractor shall perform its Work in a manner to interfere as little as possible with the normal conduct of school activities, using its best efforts to protect the safety of students, employees and School property. No interruption to, or interference with, any of the services such as heating, lighting, plumbing, etc., together with all normal means of ingress and egress to buildings and property, will be allowed without express permission of the Owner.

**3.3.7** The Contractor’s Work shall be at all times subject to the inspection and approval of the Owner. Any materials that in the opinion of the Owner do not comply with the Contract Documents will be rejected and shall be immediately removed from the site. Any workmanship that in the opinion of the Owner does not comply with the Contract Documents shall be stopped at once, and corrective measures shall be instituted at once.

**3.3.8** For a Project with multiple prime contractors, all Contractors are responsible for the coordination and integration of their respective scopes of Work. The General Trades Contractor is responsible for making all coordination decisions not mutually agreed upon by affected Contractors. The Owner and its consultants or agents shall not be liable for any costs incurred by any Contractor due to failure of Contractors to coordinate and integrate their Work or due to any delays in the Work. If a Contractor causes damages or additional costs to another Contractor (including by causing delays, interferences, hindrances, loss of efficiencies or acceleration of Work), an adversely impacted Contractor will have a third-party beneficiary claim for legal action against the responsible Contractor. All Contractors acknowledge and accept the right of other Contractors to bring such third-party beneficiary claims, waive any privity of contract defense against such claims, and agree not to include the Owner, its professional consultants or agents, as parties in any such legal action.

**3.3.9** Contractor shall not assign its duties under this Agreement without the express written approval of Owner.”

**1.12 Add the following Subparagraphs 3.4.4 through 3.4.7:**

**3.4.4** All persons employed by the Contractor to perform the Work shall be competent and first-class workmen and mechanics, who are duly skilled in their respective branches of labor.

**3.4.4.1** Special Qualifications and Experience are required of the contractor and other as identified in the SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, "QUALITY ASSURANCE," Article 1.7.

**3.4.5** Should the Owner object in writing to any personnel of Contractor or any Subcontractor, such personnel shall not perform services on the Project, and there shall be no change in the Contract Sum as a result of such objection.

**3.4.6** The Contractor shall assign an on-site Superintendent for the project who shall not be replaced so long as the Superintendent remains in the Contractor's employment without written consent by the Owner, and who shall be replaced without any change in the Contract Sum if the Owner, in its discretion, so requires.

**3.4.7** Background Check Requirements (Act 34 and Act 151): For any employee or other representative of the Contractor or its subcontractors who enters the work site, the Contractor shall provide the District originals (or notarized copies satisfactory to the Owner) of criminal record and child abuse background check reports. When an original background check report is provided, the Owner will copy and return the original to the Contractor. The reports must be provided before any employee or other representative of the Contractor or its subcontractors enters the work site. Failure to comply with these requirements is a breach of the contract between the Contractor and the Owner, will result in withholding of contract payments, and may result in assessment of penalty under applicable law. The Contractor is responsible for ensuring compliance with these requirements by all its subcontractors. Required reports include criminal history record information from Pennsylvania State Police, and FBI pursuant to the School Code, 24 P.S. § 1-111 (Act 34). Such criminal history record information shall be no more than five years old. As to child abuse reports, the Contractor must provide for all such individuals an official clearance statement pursuant to the Child Protective Services Law, 23 Pa. C.S.A. § 6355 (Act 151). Such child abuse information shall be no more than five years old."

**1.13 Change Subparagraph 3.5.1 as follows:**

- In the second line after "good quality and new" insert "and of recent manufacture."
- Change fourth sentence to read as follows:  
"The Contractor's warranty excludes remedy for damage or defect caused by abuse which is not the responsibility of the Contractor, modifications not executed by the Contractor, or improper or insufficient maintenance or improper operation which is not the responsibility of the Contractor, or normal wear and tear under normal usage."

**1.14 Add Subparagraph 3.6.1 as follows:**

**3.6.1** No sales tax or use taxes shall be paid on construction activities which the Commonwealth of Pennsylvania's Department of Revenue has determined to be tax exempt (Sales and Use Tax Regulation 150) relating to School Districts and Non-Profit Construction."

**1.15 Add the following Subparagraph 3.6.2:**

"3.6.2 The Contractor shall claim tax exemptions for items that are tax exempt. The Contractor assigns to the Owner the right to collect any refund of taxes that are paid on tax exempt items."

**1.16 Subparagraph 3.7.3** add "or having reason to know" after "knowing" in the first sentence.

**1.17 Add Subparagraph 3.9.4 as follows:**

"3.9.4 The Prime Contractors and Subcontractors shall send authorized representatives to job meetings, with power to make binding commitments on all matters. The Owner reserves the right to request replacement of, and the Contractors agree to replace, or cause to be replaced in the case of subcontractors, such representative(s) if the Owner and Architect find that adequate reason exists for that request."

**1.18 Subparagraph 3.10.3** at the end of the sentence, add "and in accordance with the time limits in the Contract Documents."

**1.19 Add the following Subparagraph 3.11.1:**

"3.11.1 Throughout the progress of construction, each Contractor shall mark up a set of Record Drawings (prints) recording all changes that job conditions require, and which are not shown on the Contract Drawings. At the completion of the Project, the set of marked up drawings shall be delivered to the Architect in good and legible condition. Final payment shall not be made until completed Record Drawings are submitted to the Architect."

**1.20 Add the following Subparagraph 3.13.1:**

"3.13.1 Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. Materials or equipment no longer required for the Work shall be promptly removed from the Project site. Protection of construction materials and equipment stored at the Project site from weather, theft, damage, or all other adversity is solely the responsibility of the Contractor."

**1.21 Add the following Subparagraph 3.16.1:**

"3.16.1 Representatives of governmental agencies shall have access at all reasonable times to inspect the Work, and the Contractor shall provide proper facilities for such access and inspection."

**1.22 Change Subparagraph 3.18.1 as follows:**

Delete from the first sentence of 3.18.1 the following: "...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)."

**1.23 Add the following to Subparagraph 4.2.12:**

"For incidental items only, the Contractors agree to comply with field orders or instructions of the Architect, or additional detail drawings reasonably consistent with the Contract Documents, without claiming extra compensation or time extension."

**1.24 Add the following Subparagraph 4.2.15:**



“4.2.15 The Owner may hire the services of a Construction Manager to assist with the administration of the contract. The services of the Construction Manager shall be to represent the Owner and assist with the project as far as coordination of activities, maintaining project schedules, facilitating the processing of project documents, reviewing of payment applications, and communications among Contractors, Architect, Consultants and Owner. The addition of the services of a Construction Manager does not relieve the Contractor(s) of any of the requirements or obligations for project responsibilities identified in the Project Documents.”

**1.25 Add Subparagraph 5.1.3 as follows:**

"5.1.3 A Supplier is a person or entity who has a direct or indirect contract with the Contractor, Subcontractor or Sub-subcontractor to furnish materials or equipment for the Work. The term "Supplier" is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Supplier or an authorized representative of the Supplier."

**1.26 Change Subparagraph 5.2.1 as follows:**

In the second sentence, delete the word "reasonable".

**1.27 Change Subparagraph 5.2.3 as follows:**

In the first sentence delete the word "reasonable", and delete the second and third sentences entirely.

**1.28 Add the following Subparagraph 7.2.2:**

"7.2.2 In Clause 7.2.1.2 above, the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the schedule contained in Clauses 7.3.11.1 through 7.3.11.5."

**1.29 Change Clause 7.3.3.1 as follows:**

Add at the end, "and with an allowance for overhead and profit in accordance with the schedule set forth in Subparagraph 7.3.11."

**1.30 Change Subparagraph 7.3.4 as follows:**

In the first sentence, delete the words "an amount for overhead and profit" and substitute "an allowance for overhead and profit in accordance with the schedule set forth in Subparagraph 7.3.11."

**1.31 Add the following Subparagraph 7.3.11:**

"7.3.11 In Clause 7.3.3.1 and in Subparagraph 7.3.4, the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the following schedule:

1. For the Contractor; for any Work performed by the Contractor's own forces, fifteen percent (15%).
  - a. Labor costs shall include the certified Base Prevailing Wage Rate (or the base wage rate if the Prevailing Wage Act is not applicable to the Project), plus actual fringe benefits per wage determination plus 25% for FICA, SUTA, FUTA, and Worker's Compensation. No costs beyond those listed will be considered. Total labor cost for the Contractor's employees shall be this cost plus a mark-up of 15% for overhead and profit. This mark-up includes all overhead, including supervisory personnel, estimators, staff, office time, etc.
  - b. Material, Supplies, and Equipment costs shall be the invoice cost, plus sales tax (if applicable), plus a mark-up of 10% for overhead and profit.
  - c. Bonds and Insurance costs shall be submitted without mark-up.

2. For the Contractor, for work performed by his Subcontractor or material supplier, five percent (5%) of the amount due the Subcontractor.
  - a. Subcontractor Labor invoice for hourly wages and materials costs shall be in accordance with the definitions listed above.
3. For each Subcontractor or Sub-subcontractor involved, for any Work performed by that Contractor's own forces, fifteen percent (15%) of the cost.
4. For each Subcontractor, for Work performed by his Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractor.
5. Cost to which overhead and profit is to be applied shall be determined in accordance with Clauses 7.3.4.1 through 7.3.4.5."

**1.32 Add the following Subparagraph 7.3.12:**

"7.3.12 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Labor and materials shall be itemized in the manner prescribed above; labor costs shall be actual costs (wages and benefits), not standardized billing rates and shall be limited to the items listed in .1 below. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over \$300.00 be approved without such itemization."

1. Costs of Labor shall be subject to the limitations listed in 7.3.11.1(a) of the Supplemental Conditions of the Contract.

**1.33 Change Subparagraph 8.1.3 as follows:**

After "Architect" insert "and approved by the Owner."

**1.34 Add the following Subparagraph 8.2.1.1:**

"8.2.1.1 Any preliminary schedule, if provided, is for information purposes only and constitutes a proposed sequence of events based on standard practices. Bidders shall not rely on date or durations suggested by this schedule. The Contractors are responsible to provide the Construction Manager and/or Architect a detailed Construction Schedule of their work within fifteen (15) business days after the date of written notice of Bid Award and a Construction Progress Schedule will be developed and updated periodically."

**1.35 Delete Subparagraph 8.3.1 in its entirety and replace with the following:**

"8.3.1 In the event of Project delay that the Owner determines in its discretion to be beyond the reasonable control or anticipation of the Contractor, the Owner may approve a Change Order extending the Contract Time. The Contractor shall not, though, assert any claim for additional payment due to, relating to or arising from Project delay. Should the Contractor violate this provision and assert a claim for additional payment due to, relating to or arising from Project delay, the Contractor shall be liable to the Owner for any costs incurred by the Owner (including fees charged to the Owner by attorneys, architects or other consultants of the Owner) associated with defending against such claim. See Subparagraph 8.3.3 for the right of Contractors to pursue third-party beneficiary claims against other Contractors causing Project delay."

**1.36 Add the following Paragraph 8.4 and Subparagraph 8.4.1:**

**"8.4 LIQUIDATED DAMAGES**

**8.4.1 Substantial Completion:** The Owner and each Prime Contractor recognize and acknowledge that time is of the essence of this Agreement and that Owner will suffer financial loss if any phase of

the Work is not completed within the time specified in the Agreement, plus any extensions thereof allowed in accordance with Article 8 of the General Conditions. They also recognize that delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the work is not completed on time.

Accordingly, instead of requiring any such proof, Owner and each Prime Contractor agree that as liquidated damages for delay (but not as a penalty), each Prime Contractor and the Contractors' surety shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the Work of any phase is substantially complete and such requirement shall be an event for payment by any bond provided in favor of Owner by Contractors' surety:

**Per Calendar Day Amount: Two Thousand Five Hundred dollars (\$2,500.00).**

**8.4.2 Submittal Process:** The project process and the timely submission of required shop drawings, product data, samples, and similar items specified to be submitted for review impact the project schedule and the ability of all contractors to complete the project in a timely manner. The time frame for contractors to prepare and submit information is **forty-five (45) calendar days from "Notice to Proceed"**. Each Prime Contractor shall be liable for **Liquidated Damages in the amount of Five Hundred dollars (\$500.00) per Calendar Day** for every day of delay in submitting required information."

**1.37 Add the following sentence to Paragraph 9.2:**

"The Architect can require revision of the Schedule of Values any time before Substantial Completion if he should find such Schedule inaccurate. The Schedule will be updated with each Change Order to incorporate same."

**1.38 Add the following Clause 9.3.2.1:**

**"9.3.2.1** In addition to specific items listed in Subparagraph 9.3.2 above, payment may be requested by the Contractor for the following items which shall be identified and included as separate line items in the Schedule of Values.

1. "Permits and Approval Fees", to the extent that costs are directly attributable to the Project.
2. "Performance Bond and Labor and Material Payment Bond", if furnished.
3. "General Conditions", which shall be the category covering all miscellaneous items such as cost of Contractor's insurance, Contractor's overhead, project administration and supervision, preparation of required submittals, mobilization, temporary facilities, project layout, etc. Cost assigned to General Conditions in the Schedule of Values shall be no greater than 5% of Contract Sum."
4. To facilitate evaluation of Applications for Payment, the Contractor shall identify costs for labor and material as separate line items for each breakdown item on the Schedule of Values.

**1.39 Change Subparagraph 9.4.1 as follows:**

In the first line, change "seven days" to "ten days".

**1.40 Change Subparagraph 9.5.1 as follows:**

At the end of the first sentence insert ",and the Owner may disapprove a Certificate for Payment for the same reasons."

**1.41 Change Subparagraph 9.5.1.7 as follows:**

Delete the word "repeated."



**1.42 Change Subparagraph 9.6.2 as follows:**

In the first sentence, change “seven days” to “twenty days.”

**1.43 Add the following Subparagraph 9.6.2.1:**

“9.6.2.1 In accordance with 62 Pa. C.S.A. Section 3922: In the absence of good and sufficient reasons, within 20 days of the receipt of payment by the Contractor, the Contractor shall pay all subcontractors with whom he has contracted their earned share of the payment the Contractor received. The Owner, Architect, or Construction Manager may, as a pre-condition to payment, require proof of payment to subcontractors, sub-subcontractors, and suppliers at any time and from time to time.”

**1.44 Add the following Subparagraph 9.6.9:**

“9.6.9 Until Substantial Completion, the Owner will pay ninety percent (90%) of the amount due the Contractor on account of progress payments. At the first regularly-scheduled payment after Substantial Completion, the payment shall be sufficient to increase total payments to one hundred percent (100%) of the Contract Sum less two times the Architect's estimate of sums required to complete unfinished work and settle outstanding claims and in accordance with 62 Pa. C.S.A. §3921.”

**1.45 Add the following Subparagraph 9.6.10:**

“9.6.10 When the Work is fifty percent (50%) completed, one-half of the amount retained by the Owner will be returned to the Contractor, provided the Contractor provides written consent of surety to such reduction in retainage along with its Application for Payment, provided the Construction Manager and/or Architect approved the application and reduction of retainage, and further provided that the Contractor is making satisfactory progress and there is no specific cause for greater withholding. Payments are subject to the provisions of Section 9.6.”

**1.46 Change the first sentence of Paragraph 9.7 to read as follows:**

“If the Owner does not pay the Contractor within fourteen 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.”

**1.47 Change Subparagraph 9.8.1 as follows:**

In the second line, change “occupy or utilize” to “occupy and utilize.”

**1.48 Change Subparagraph 9.10.2 as follows:**

In the first sentence after the word “until” add “the Owner has approved such payment and...”

**1.49 Delete Subparagraph 9.10.4 in its entirety and replace with the following:**

“9.10.4 The making of final payment shall not constitute a waiver of any claims by the Owner.”

**1.50 Add Subparagraph 10.2.9 as follows:**

“10.2.9 The Contractor shall:

1. Take every precaution to secure the Owner's property from theft or vandalism due to Contractor's operation.

2. Comply with orders of fire authorities, include the Owner's fire insurance company, and provide adequate fire protection equipment at site; cost of such compliance to be included in the cost of the Work."

**1.51 Delete Article 11 in its entirety and replace with the following Article and Subparagraphs:**

**"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 and completed 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' compensation, disability benefit and other similar employee benefit acts that 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;
- .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;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

**11.1.1.1** Liability Insurance shall include all major divisions of coverage and be on a comprehensive basis including:

1. Premises Operations (including X-C/U coverages).
2. Independent Contractors' Protective.
3. Products and Completed Operations.
4. Personal Injury Liability with Employment Exclusion deleted.
5. Contractual, including specified provision for the Contractor's obligation under Paragraph 3.18.
6. Owned, non-owned, and hired motor vehicles.
7. Broad Form Property Damage, including Completed Operations.
8. Umbrella Excess Liability."

**11.1.1.2** The General Liability coverages shall be provided by a Commercial General Liability Policy on an occurrence basis.

**11.1.2** The insurance required by Section 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 the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

“11.1.2.1 Contractor shall provide, pay for and maintain (and shall require Subcontractors of all tiers to provide, pay for and maintain) insurance of the type and limits set forth below. Such insurance shall be maintained in full force and effect from the commencement of the Work by Contractor until final acceptance of the entire Project or the completion of all post-acceptance warranty or related Work by Contractor, whichever is later, and shall be for both on-site and off-site Work.

- .1 Automobile Liability insurance covering all owned, non-owned, and hired vehicles used by Contractor and Subcontractors for all operations both on and off the Project Site, with a minimum limit of One Million Dollars (\$1,000,000) Combined Single Limit Per Accident for Bodily Injury and Property Damage.
- .2 Professional Liability insurance if Contractor (or applicable Subcontractors) will perform or retain others to perform professional services in connection with the Work, including engineering, architectural, medical, testing, environmental assessment or remediation, or design-build services, with a minimum limit of One Million Dollars (\$1,000,000) Per Wrongful Act, Error, or Omission.
- .3 Owned and Non-Owned Aircraft. If an aircraft, whether owned or non-owned by the Contractor or any Subcontractor, is used in connection with the Work by the Contractor or any Subcontractor of any tier, the Contractor or Subcontractor, as applicable, shall advise the Owner or its representatives, shall provide a written explanation of the planned use of the aircraft, and shall provide Aircraft Liability Insurance at its sole cost and expense, the conditions and limits to be established by the Owner. The Owner reserves the right to prohibit the use of any aircraft in connection with the Work under this Contract. The minimum limit will be Five Million Dollars (\$5,000,000). This insurance shall be primary to all other insurance.
- .4 Asbestos and/or Lead Abatement. If Contractor (or applicable Subcontractors) will perform or retain others to perform abatement services; Asbestos and/or Lead Abatement Liability Insurance with limits of Ten Million Dollars (\$10,000,000) Each Occurrence and Ten Million Dollars (\$10,000,000) Aggregate when Work includes asbestos and/or lead abatement activities.
- .5 Workers' Compensation insurance providing statutory benefit limits under Pennsylvania's Workers' Compensation law and minimum limits under Coverage Part B (Employer's Liability) of Five Hundred Thousand Dollars (\$500,000) for Each Accident for Bodily Injury by Accident, Five Hundred Thousand Dollars (\$500,000) Each Employee for Bodily Injury by Disease, and Five Hundred Thousand Dollars (\$500,000) Policy Limit for Bodily Injury by Disease. The insurance shall cover all operations of Contractor (or the applicable Subcontractor). Such insurance shall be endorsed to include "Other States Coverage".
- .6 Commercial General Liability insurance covering all Operations/ Work of Contractor (or the applicable Subcontractor). Such insurance shall be written on an Occurrence form. Coverage shall not be provided under a "Claims-Made" or "Modified Occurrence" policy without the prior, expressed written consent of Owner. Such insurance: (i) Shall be no less comprehensive and no more restrictive than the coverage provided by the standard Insurance Services Office (ISO) form CG 00 01 (07/98); (ii) shall include by its terms or appropriate endorsements Bodily Injury, Property Damage, Personal Injury, Blanket Contractual, Independent Contractors, Products and Completed Operations coverages; (iii) shall include Products Liability coverage for any products manufactured, assembled, or otherwise worked upon away from the Project Site; and (iv) shall include coverage for "x" (explosion), "c" (collapse), and "u" (underground) exposures. Such insurance shall have the following minimum limits:
  - a. For the Contractor:
    - 1) \$5,000,000 Each Occurrence;
    - 2) \$5,000,000 General Aggregate; and
    - 3) \$5,000,000 Products/Completed Operations Aggregate
  - b. For all Subcontractors:



- 1) \$1,000,000 Each Occurrence;
  - 2) \$2,000,000 General Aggregate; and
  - 3) \$1,000,000 Products/Completed Operations Aggregate
- .7 Umbrella Excess Liability:
- a. All Prime Contractors: \$1,000,000 over Primary Insurance.

**11.1.3** Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

**11.1.3.1** The cancellation notice on the Certificate of Insurance, ACORD Form 25S, shall be revised to read 'Should any of the above-described policies be canceled before the expiration date thereof, the issuing company will mail 30 days' written notice to the certificate holder named to the left.' In addition to ACORD Form 25S, AIA Document G715 shall also be completed, in full, and submitted.

**11.1.3.2** The Contractor shall provide insurance coverage for portions of the work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the work in transit.

**11.1.4** The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

**11.1.5** The Contractor shall purchase insurance from a company having an A. M. Best & Co. rating of 'A' or better.

**11.1.6** The Contractor shall make the Reading Muhlenberg Career and Technology Center an Additional Insured. He shall provide an endorsement from his insurance carrier (in addition to Certificate required above) to the Owner within two weeks after execution of the Agreement stating that this subparagraph has been complied with. The endorsement shall obligate the insurance carrier to give the Owner thirty (30) days' notice of cancellations of the insurance coverage(s).

## **11.2 OWNER'S LIABILITY INSURANCE**

**11.2.1** The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

## **11.3 PROPERTY INSURANCE**

**11.3.1** The Owner shall provide Builder's Risk Insurance at its option.

## **11.4 PERFORMANCE BOND AND PAYMENT BOND**

**11.4.1** The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder. Bonds shall be obtained from a company lawfully authorized to do business in the Commonwealth of Pennsylvania and have Best's ratings of 'A' or better; and the cost of the bonds shall be included in the Contract Sum. The amount of each bond shall be equal to 100 percent of the Contract Sum.

**11.4.1.1** The Contractor shall deliver the required bonds to the Owner not later than three days following the date Agreement is entered into, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

**11.4.1.2** The Contractor shall require the attorney who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the Power of Attorney.

**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 authorize a copy to be furnished."

**1.52 Delete Subparagraph 12.2.2.3 in its entirety.**

**1.53 Add to Article 13 of General Conditions the following paragraphs 13.6 through 13.12:**

**"13.6 PENNSYLVANIA PREVAILING WAGE RATES**

**13.6.1** Attention is called to the fact that not less than the minimum salaries and wages set forth in the Pennsylvania Prevailing Wage Rates and identified in the Contract Documents must be paid on this project. This regulation and the general Pennsylvania prevailing minimum wage rates, (Act 442 of 1961, P.L. 987, amended), as determined by the Secretary of Labor and Industry, which shall be paid for each craft or classification of all workers needed to perform the contract during the anticipated term therefor in the locality in which public work is performed, are made part of this specification.

- a. State Prevailing Wage Rate schedules are included in the project's construction documents.
- b. It is the Bidder's responsibility to perform and to adhere to all related administrative functions, as required by the Commonwealth of Pennsylvania.
- c. Refer to Section 012160 for additional information and for the applicable prevailing wage rate determinations for the PENNSYLVANIA PREVAILING WAGE ACT

**13.7 DISCRIMINATION PROHIBITED AND COMPLIANCE WITH ADA**

**13.7.1** According to 62 Pa. C.S.A. § 3701, the Contractor agrees that: at its own expense, shall conform to the nondiscrimination policies and plans required by the Contract Documents, the laws of the Commonwealth of Pennsylvania and all other laws applicable to the Project.

**13.7.2** In the hiring of employees for the performance of work under the contract or any subcontract, no contractor, subcontractor, or any person acting on behalf of the contractor or subcontractor shall by reason of gender, race, creed or color discriminate against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.

**13.7.3** 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 the contract on account of gender, race, creed or color.

**13.7.4** The contract may be canceled or terminated by the owner or government agency, and all money due or to become due under the contract may be forfeited for a violation of the terms or conditions of that portion of the contract.

**13.7.5** Unless exempted by law, Contractor shall include the requirements of this section in every subcontract or purchase order so that it will be binding upon each subcontractor or supplier of the Contractor.

**13.7.6** In the event the Contractor believes it necessary to modify its sequence of Work, the work environment or means and methods to comply with the applicable requirements of the Americans with Disabilities Act (ADA), Contractor shall notify the Architect and Owner in writing of the proposed modification. The Architect and Owner shall have a reasonable period of time to review the request before responding in writing to Contractor. All costs of the proposed modifications shall be borne by Contractor, including impact costs to other Contractors or other parts of the Project, including any

claims arising there-from. Contractor shall implement no modification until he receives written consent from the Architect.

**13.7.7** If Contractor, its employees, subcontractors, suppliers or any other person or entity responsible to Contractor fails to comply with any applicable law or requirement of this Agreement or the Contract Documents, upon notice from the Architect or Owner, Contractor shall commence to cure such non-compliance within twenty-four (24) hours and shall achieve compliance within seventy-two (72) hours of receipt of written notice. Any failure of Contractor to do so after written notice to comply shall constitute a breach of contract and the Owner, in addition to its other rights in the event of a breach, shall have the right to terminate Contractor's right to perform the Work

### **13.8 HUMAN RELATIONS ACT**

**13.8.1** 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 Agreement, by reference. Your attention is directed to the language of the Commonwealth's non-discrimination clause in 16 PA. Code 49.101.

### **13.9 PUBLIC WORKS EMPLOYMENT VERIFICATION ACT**

**13.9.1** Contractor shall comply with all applicable provisions of Pennsylvania's Public Works Employment Verification Act, 43 P.S. § 167.1, et seq. In accordance with the Act, the Contractor will use the E-Verify Program operated by the Department of Homeland Security to verify the employment eligibility of each new employee hired after January 1, 2013 within five (5) business days of the hire date. Prior to commencing work, the Contractor shall fully and accurately complete a Commonwealth of Pennsylvania Public Works Employment Verification Form and shall provide that form to the Owner. The Public Works Employment Verification Form can be obtained on the website of Pennsylvania's Department of General Services:

<https://www.dgs.pa.gov/Materials-Services-Procurement/Public-Works-Employment-Verification/Documents/UPDATED%20Public%20Works%20Employment%20Verification%20Form.pdf>

For all new employees hired during the course of the Project, the Subcontractor must continue to use the E-Verify Program to verify their employment eligibility. <https://www.e-verify.gov/>

1) Contractor's subcontractors, at any tier, are also required to comply with the provisions of the Public Works Employment Verification Act. If Subcontractor enters into any subcontracts relating to the Project, the subcontracts must contain information about the requirements of the Public Works Employment Verification Act, and must identify that the applicable form may be obtained at

<https://www.dgs.pa.gov/Materials-Services-Procurement/Public-Works-Employment-Verification/Documents/UPDATED%20Public%20Works%20Employment%20Verification%20Form.pdf>.

### **13.10 STANDARD OF QUALITY**

**13.10.1** The various materials and products specified in the specifications by name or description are given to establish a standard of quality and of cost for bid purposes. Except for a limited selection of products which are specifically identified in the contract documents, 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 describe the minimum standard. When proprietary names are used and are followed by the words "no alternatives or substitutions shall be accepted," only the specific product identified can be provided. This limitation is restricted to a limited selection of products for this project. When proprietary names are used as a standard of quality, they shall be followed by the words "or alternatives of the quality necessary to meet the specifications." 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.



### **13.11 USE OF STEEL AND STEEL PRODUCTS MADE IN THE UNITED STATES**

**13.11.1** In accordance with Act 3 of the 1978 General Assembly of the Commonwealth of Pennsylvania, if any steel or steel products are to be used or supplied in the performance of the contract, only those produced in the United States as defined therein shall be used or supplied in the performance of the contract or any subcontracts thereunder.

**13.11.1.1** In accordance with Act 161 of 1982, cast iron products are also included and shall be produced in the United States. Act 144 of 1984 further defines "steel products" to include machinery and equipment. The act also provides clarification and penalties.

### **13.12 COMPETENT WORKMEN**

**13.12.1** 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 as current rates of wages paid for such hours by employers of organized labor in doing similar work in the district where work is being done."

**1.54 In Subparagraph 14.1.1, delete Clause 14.1.1.3.**

**1.55 Change Subparagraph 14.2.1 as follows:**

- In subparagraph 14.2.1.1 delete "repeatedly".
- In subparagraph 14.2.1.3 delete "repeatedly".
- In subparagraph 14.2.1.4 delete "substantial".

**1.56 Change Subparagraph 14.4.3 as follows:**

Delete the remainder of the sentence following the word "executed."

**1.57 Delete Subparagraph 15.1.2 in its entirety.**

**1.58 Add the following to Subparagraph 15.1.6.1:**

After the last sentence, add "Extension of time shall be the sole recourse for delays and shall not act as an entitlement for damages due and owing the Contractor for said delays."

**1.59 Delete Subparagraphs 15.2.6 and 15.2.6.1 in their entirety.**

**1.60 Delete Paragraph 15.3 and Subparagraphs 15.3.1 through 15.3.4 in their entirety.**

**1.61 Delete Article 15.4 and Subparagraphs 15.4.1 thru 15.4.4.3 in their entirety, and replace with the following:**

#### **"15.4 ARBITRATION**

**15.4.1** Any controversy, dispute or Claim arising hereunder that is not resolved to the satisfaction of all parties by the Architect as described in subparagraph 15.2 shall be resolved by binding arbitration only if arbitration is selected by the Owner, pursuant to the rules of the American Arbitration Association. In the absence of such selection by the Owner, any controversy, dispute or Claim arising out of or related to the Contract Documents, or the breach thereof, shall be settled by non-jury trial in the Court of Common Pleas in the county where the Project is located or any and all other judicial and administrative remedies as otherwise provided by laws of the Commonwealth of Pennsylvania."

**1.62 Add to General Conditions the following Article 16:**

**"ARTICLE 16 MECHANICS' LIENS**

**16.1** Contractor shall promptly pay for all materials furnished, labor supplied or performed by others, rental for equipment employed, and services rendered by public utilities in or in connection with the prosecution of the work, whether or not the said material, labor, equipment, and services entered into and become component parts of the work or improvement contemplated. This provision is intended to assure payment of every person, co-partnership, association or corporation who, as subcontractor or otherwise has furnished material, supplied or performed labor, rented equipment or supplied services in connection with the prosecution of the work as aforesaid, and shall preclude the filing by any such person, co-partnership, association or corporation, of any mechanic's lien claim against Owner for such material, labor, or rental of equipment.

**16.2** The Contractor, for any and all subcontractors and parties acting through, or under them or any of the, covenants and agrees by and with the Owner that no mechanic's liens or claims shall be filed or maintained by the said Contractor or any subcontractors or other party acting through or under it, them or any of them against the aforesaid building and/or the lot of ground or curtilage appurtenant thereto, or against the interests of the Owner on account of any work done or materials furnished by them or any of them whether prior to the execution of this Contract, under the aforesaid contract or under any supplemental contract thereto for extra or additional work or otherwise for, toward, in or about the work on the lot of ground hereinabove described, or any work or material therefor, and the said Contractor for itself and its subcontractors and all persons acting for or under it, them or any of them hereby expressly waives and relinquishes the right to have, file, or maintain any mechanic's claim or liens against the said building and/or the lot of ground hereinabove described or curtilage appurtenant thereto; to the interest of the Owner, it being the intent of the parties hereto that Contractor shall only possess those rights and remedies against Owner which are created by the terms and provisions of this Agreement and are based upon the contractual relationship between Owner and Contractor as defined and limited by this Agreement and any changes or modifications thereto.

**16.3** Contractor further agrees that if, notwithstanding the foregoing, any suit, lien or claim occasioned by the Contractor's performance of this Contract, whether directly or indirectly, is filed by the Contractor, its Subcontractor, sub-subcontractors, materialmen, or suppliers in any court having jurisdiction of the premises and the same matures into a lien against the property, Contractor shall immediately cause such lien to be discharged as to such property by posting bond or by such other means as may be provided under the applicable statutes and rules of court or shall otherwise indemnify, defend and save Owner harmless on account of any such claims, liens, or suits."

END OF SECTION 007300



COMMONWEALTH OF PENNSYLVANIA

**PUBLIC WORKS EMPLOYMENT VERIFICATION FORM**

Date \_\_\_\_\_

Business or Organization Name (Employer) \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Contractor

Contracting Public Body \_\_\_\_\_

Contract/Project No \_\_\_\_\_

Project Description \_\_\_\_\_

Project Location \_\_\_\_\_

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

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

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

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





**SECTION 011000 - SUMMARY**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Work under Owner's separate contracts.
6. Owner-furnished/Contractor-installed (OFCI) products.
7. Contractor's use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Reading Muhlenberg Career and Technology Center  
Program Upgrades
- 1. Project Location: Reading Muhlenberg Career and Technology Center  
2615 Warren Road  
Muhlenberg Township, Berks County, PA 19604

- B. Owner: Reading Muhlenberg Career and Technology Center  
2615 Warren Road  
Reading, PA 19604
1. Owner's Representative: Chad Heffner, Facilities  
Email: [cheffner@rmctc.org](mailto:cheffner@rmctc.org)  
Phone: (610) 921-7300
- C. Architect: Muhlenberg Greene Architects, Ltd.  
955 Berkshire Blvd. Suite 101  
Wyomissing, PA 19610
1. Architect's Representative: James A. Sarro, AIA, LEED AP+  
Email: [JimS@MG-Architects.com](mailto:JimS@MG-Architects.com)  
Phone: (610) 376-4927
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
1. M,E,P Engineers: Consolidated Engineers  
1022 James Drive  
Leesport, PA 19533
- a. Mechanical Engineer Representative: Bob Chubb  
Email: [bobc@cemec.com](mailto:bobc@cemec.com)  
Phone: (610) 916-1600 X116
- b. Electrical Engineer Representative: John Schulze  
Email: [johnc@cemec.com](mailto:johnc@cemec.com)  
Phone: (610) 916-1600 X130
2. Site / Civil Engineers: Stackhouse Bensinger, Inc.  
330 Revere Boulevard  
Sinking Spring, PA 19608
- a. Civil Engineer Representative: Stephen Bensinger, RLA, ASLA  
Email: [sbensinger@stseinc.com](mailto:sbensinger@stseinc.com)  
Phone: (610) 777-8000
3. Structural Engineers: Di Genova Associates, Inc.  
1212 Germantown Pike, Suite 5  
Plymouth Meeting, PA 19462
- a. Structural Engineer Representative: Sam Di Genova, PE  
Email: [sdigenova@digenovaassociates.com](mailto:sdigenova@digenovaassociates.com)  
Phone: (610) 270-9511
- E. Project Coordinator for Multiple Contracts:
1. General Contractor shall serve as Project Coordinator. See Section 011200 "Multiple Contract Summary" for responsibilities of Project Coordinator.



1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
1. The work scheduled at the Reading Muhlenberg Career and Technology Center includes renovations and upgrades to selected areas of the existing building, the new construction for a new Welding Classroom Building, and Site Modifications. The interior renovations and alterations include the combining of two existing classrooms to create one larger classroom to house the 3D Fabrication Program as well as modifications to the existing HVAC systems, upgrades to the lighting and electrical systems, new finishes, as well as other Work indicated in the Contract Documents.
- B. Type of Contract:
1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.6 PHASED CONSTRUCTION

- A. Construct the Work in phases, with the work of each phase as indicated on Drawings and summarized below substantially complete by the dates indicated.
1. **Phase 'A' Work** at areas defined on the drawings includes but is not limited to:
    - a. Site preparation for the new building.
    - b. Excavation, to run utilities for new building.
    - c. Construction of the new welding building.
    - d. Excavation, foundations, steel construction, exterior envelope.
    - e. Parking lot modifications.
    - f. Relocation and Installation of existing welding equipment.
  2. **Phase 'A' Schedule:**
    - a. **Commencement of Construction Activities:**
      - 1) Notice to Proceed: Work of this phase shall commence with the Notice to Proceed anticipated to be issued mid-July 2022.
      - 2) On-Site Start Date: On-Site Work of this phase shall commence by August 1, 2022. Construction activities on site are limited to areas indicated on the phasing plan and not requiring access to school areas occupied for students and staff until after the last day for students, which is anticipated to be on June 7, 2022.

- b. **Phase 'A' Substantial Completion:**
    - 1) No later than May 1, 2023 for new work areas NOT affecting the School's use and occupancy for the school year.
  - 3. **Phase 'B' Work** at areas of the building defined on the drawings includes, but is not limited to:
    - a. Interior renovations of areas in the existing building.
    - b. Modifications to existing mechanical and plumbing systems.
    - c. Replacement of existing lighting at selected areas.
    - d. Relocation and installation of existing machine shop equipment.
  - 4. **Phase 'B' Schedule:**
    - a. **Commencement of Construction Activities:**
      - 1) Work of this phase shall commence with the Notice to Proceed to permit the initial ordering and purchasing of materials, preparation of needed shop drawings and submittals, and other preliminary work for the project.
      - 2) On-Site Start Date: On-Site Work of this phase shall commence on June 5, 2023 **OR** following the last day for students and staff at the building.
    - b. **Phase 'B' Substantial Completion:**
      - 1) No later than August 14, 2023 for all areas affecting the School District's use and occupancy for the start of the school year.
- 1.7 WORK PERFORMED BY OWNER
- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
  - B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before Work under this Contract begins.
    - 1. Owner's personnel will clear interior work areas of moveable furniture and furnishings intended to be reused following construction activities.
    - 2. General Contractor will be responsible to clear all fabrication equipment from both the current welding and 3D fabrication classrooms and be responsible for its reinstallation.
- 1.8 WORK UNDER OWNER'S SEPARATE CONTRACTS
- A. Concurrent Work: Owner will award a separate contract for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
    - 1. Testing and Inspections: To an authorized testing and inspection agency to perform quality control testing and inspections specifically assigned to the Owner in the specifications issued for this project.

2. Commissioning: To Agency solicited under separate invitation for Commissioning of the mechanical equipment and control systems installed as part of this project.

#### 1.9 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
  - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

- B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

- C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Toilet Room Accessories:
  - a. Paper Towel and Toilet Paper Dispensers scheduled for the new building.
2. Monitors and Projectors:
  - 1) Ceiling mounted projectors are scheduled at the new building and other locations as noted on the drawings. Coordinate final locations with the school for installation of ceiling hung support brackets.

#### 1.10 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Each Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.



- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Limits on Use of Site: Confine construction operations to areas indicated on the site plan for contractor use.
  - 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

#### 1.11 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
  - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
  - 3. See Section 015000 "Temporary Facilities and Controls" for constructing barriers to separate construction areas from occupied areas of the building.

#### 1.12 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 4:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: Weekend hours may be scheduled with prior approval by the School District.
  - C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during scheduled school activities or selected days for testing during school hours.
  - D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions:
    1. Notify Architect and Owner not less than five days in advance of proposed utility interruptions.
    2. Obtain Owner's written permission before proceeding with utility interruptions.
  - E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
    1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
  - F. **Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on School District property is NOT permitted.**
  - G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
  - H. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site.
    1. Procedures for acquiring background checks for all personnel are identified in the Supplemental Conditions of the Contract included in the Project Manual.
    2. Maintain list of approved screened personnel with Owner's representative.
- 1.13 SPECIFICATION AND DRAWING CONVENTIONS
- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
    1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
    2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
    3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
    4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



## SECTION 011200 - MULTIPLE CONTRACT SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls.
- B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.
- C. Related Requirements:
  - 1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, **phased construction**, coordination with occupants, and work restrictions.
  - 2. Section 013100 "Project Management and Coordination" for general coordination requirements.

#### 1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, the condition at which roofing is insulated and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

#### 1.4 PROJECT COORDINATOR

- A. Project coordinator shall be responsible for coordination between the **General Construction Contract, Plumbing Contract, HVAC Contract and Electrical Contract**.
  - 1. Coordination activities of the **Project Coordinator shall be included in the scope of work of the General Construction Contract.** General Construction Contractor shall provide a qualified and experienced Project Coordinator.

#### 1.5 PROJECT COORDINATOR RESPONSIBILITIES

- A. Project coordinator shall perform Project coordination activities for the multiple contracts, including, but not limited to, the following:

1. Provide typical overall coordination of the Work.
  2. Coordinate shared access to workspaces.
  3. Provide protection of existing surfaces in work areas and along contractor access routes through the existing building.
  4. Coordinate product selections for compatibility.
  5. Provide overall coordination of temporary facilities and controls.
  6. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.
  7. Coordinate construction and operations of the Work with work performed by each Contract.
  8. Prepare coordination drawings in collaboration with each contractor to coordinate work by more than one contract.
  9. Coordinate sequencing and scheduling of the Work. Include the following:
    - a. Initial Coordination Meeting: At earliest possible date, arrange and conduct a meeting with contractors for sequencing and coordinating the Work; negotiate reasonable adjustments to schedules.
    - b. Prepare combined Contractors' Construction Schedule for entire Project. Base schedule on preliminary construction schedule. Secure time commitments for performing critical construction activities from contractors. Show activities of each contract on a separate sheet. Prepare a simplified summary sheet indicating combined construction activities of contracts.
      - 1) Submit schedules for approval.
      - 2) Distribute copies of approved schedules to contractors.
  10. Provide photographic documentation.
  11. Provide quality-assurance and quality-control services specified in Section 014000 "Quality Requirements."
  12. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections.
  13. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
  14. Locate existing permanent benchmarks, control points, and similar reference points, and establish permanent benchmarks on Project site.
  15. Provide field surveys of in-progress construction and site work **and final property survey**.
  16. Provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one contractor has worked.
  17. Coordinate cutting and patching.
  18. Coordinate protection of the Work.
  19. Coordinate firestopping.
  20. Coordinate completion of interrelated punch list items.
  21. Coordinate preparation of Project Record Documents if information from more than one contractor is to be integrated with information from other contractors to form one combined record.
- B. The **General Construction Contractor** shall be designated as the "Project Coordinator" with respect to job site safety. Responsibilities and authority of Project Coordinator for Project Site Safety include, but are not limited to, the following:
1. The Project Coordinator will be responsible to inspect and maintain safe working conditions on the job site.

2. Where the work of one (1) Contractor places another Contractor's workers in jeopardy, the "Project Coordinator" shall direct and coordinate the effort of the Contractors to ensure that job site safety is maintained.
3. The Project Coordinator will maintain a "competent person" on site at all times designated to make safety inspections and to serve as the designated representative in charge of safety during inspection by OSHA employees.
4. The Project Coordinator may direct another Contractor to make corrections in the event of a safety violation. Failure of another Contractor to take prompt action (within 24 hours following written notice) to correct a safety violation shall empower the Project Coordinator to make the necessary corrections and to receive full compensation for such corrections directly from the Owner. The Architect will verify and provide documentation of time and material expended to make corrections. The Owner in turn will recover the amount of the expense from the offending Contractor through deduct Change Order.
5. In addition to the responsibilities listed here the Project Coordinator's responsibilities and corresponding authority shall be as defined in the General Conditions of the Contract for Construction.
6. The individual Prime Contractors will maintain primary responsibility for the safety of their workers. The "Project Coordinator" will serve to identify areas of concern and will endeavor to accomplish required corrections through cooperation of other Prime Contractors.
7. Project Coordinator shall provide regular and periodic safety inspections and prepare reports. Inspections and reports shall be performed at least once each month.
8. Each Prime Contractor shall provide a safety representative who is trained in first aid and CPR.

#### 1.6 GENERAL DESCRIPTION OF CONTRACTS

- A. The Work of this Project shall be performed under FOUR Prime Contracts, as defined in this Section.
- B. The following is a list of the Prime Contracts to be bid for this project:
  1. Contract 1: General Construction
  2. Contract 2: Plumbing Construction
  3. Contract 3: HVAC Construction
  4. Contract 4: Electrical Construction
- C. The General Conditions and Division 01 - General Requirements shall apply to all Prime Contracts and Subcontracts for this Project. Each Prime Contract Package Description is to include all Work in accordance with the Contract Documents, except Work covered by other Prime Contract Package Descriptions. Collectively, these Prime Construction Contracts include all materials, labor, supervision, transportation, tools, equipment and services for the Project as shown or implied on the drawings and specified herein, or as may be required or necessary for a complete and satisfactory job.
- D. If there is a conflict on a specific item with regards to assignment of work to a specific contractor between the Contract Documents and the Prime Contract Package Description as stated herein, the Prime Contract Package Description will govern; however, if an item is covered in the Contract Documents, but not reiterated in the Prime Contract Package Description, the Bidder will be responsible for that item of work.



- 1. If an item is covered in two or more contract package descriptions, each Contractor shall include the item at the time of bid. After Contract award, a credit will be solicited for work in question.**
  - E. Each Contractor shall supervise his Work, using his best skills and attention. He shall be solely responsible for construction means, methods, techniques, sequences, dimensions, and procedures and/or coordinating all portions of their Work, with all Work to be performed under separate contracts and/or other Bid Packages. Refer to the General Conditions Article 6 on work by Separate Contractors or by owner.
  - F. All items of work listed under the Prime Contract Package Descriptions shall be provided by the Prime Contractor unless specifically noted as furnished or installed only.
  - G. All Prime Contractors shall maintain site conduct in accordance with the rules and procedures specified under the General Conditions.
  - H. All Prime Contractors shall maintain, contribute to and coordinate the schedule as outlined in Specification Section 013200.
  - I. There is no known asbestos within the areas of work scheduled at the project building.
    1. If a contractor should encounter materials suspected to contain asbestos that contractor should immediately bring this discovery to the attention of the Architect.
  - J. Contract Documents include all Drawings, Specifications, Contract Descriptions, etc. for the work of the Program Upgrades at the Reading Muhlenberg Career and Technology Center. Each Prime Contractor shall review all Documents in their entirety.
  - K. MG Architects will submit the documents to the local Authority Having Jurisdiction for the building permit review. Each Prime Contractor shall be responsible to pay for, secure, and include in their Base Bid price the respective Building Permit fee required for their work on the Project. All other miscellaneous fees, permits and inspections are the responsibility of the appropriate Prime Contractors. The cost of permits and fees shall be included in the cost of each prime contract and shall be identified in the contractor's schedule of values.
  - L. The installing Prime Contractors will provide testing and inspection services of all work as indicated in the technical specifications and in Section 014000 unless specifically designated to Owner or others.
  - M. Each Prime Contractor shall be responsible to return all laydown, storage and work areas to their original condition except areas designated on the site utilization plan, which shall be the responsibility of the General Construction Contractor. Confirmation of completion of this requirement shall be necessary prior to release of final payment.
- 1.7 REQUIREMENTS OF CONTRACTS
- A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.

1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
  2. Trenches and other excavation for the work of each contract shall be the work of **each contract for its own work**.
  3. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of **each contract for its own work**.
  4. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation of access panels shall be the work of **the General Construction Contract**.
  5. Equipment pads for the work of each contract shall be the work of **each contract for its own work**.
  6. Roof-mounted equipment curbs for the work of each contract shall be the work of **each contract for its own work**.
  7. Painting for the work of each contract shall be the work of **each contract for its own work**.
  8. Cutting and Patching: **Provided under each contract for its own work**.
  9. Through-penetration firestopping for the work of each contract shall be provided by **each contract for its own work**.
  10. Contractors' Startup Construction Schedule: Within **five** working days after startup horizontal bar-chart-type construction schedule submittal has been received from Project coordinator, submit a matching startup horizontal bar-chart schedule showing construction operations sequenced and coordinated with overall construction.
- B. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.
1. **Project coordinator** shall coordinate substitutions.
- C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
  2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
  3. Its own field office, complete with necessary furniture, utilities, and telephone service.
  4. Its own storage and fabrication sheds.
  5. Temporary enclosures for its own construction activities.
  6. Staging and scaffolding for its own construction activities.
  7. General hoisting facilities for its own construction activities, up to **2 tons (2000 kg)**.
  8. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
  9. Progress cleaning of work areas affected by its operations on a daily basis.
  10. Secure lockup of its own tools, materials, and equipment.
  11. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
- D. Temporary Heating, Cooling, and Ventilation: **The HVAC Contract** is responsible for temporary heating, cooling, and ventilation, including utility-use charges, temporary meters, and temporary connections.

1.8 GENERAL CONSTRUCTION CONTRACT

- A. Work of the this Prime Contract Package Description includes, but is not limited to, the Work detailed by the following Specification Sections and as shown or implied and indicated on the Drawings and as described in the narrative Contract Description. The work is not restricted by division of Drawings or Specification. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and whatever is necessary to complete the work in accordance with the Specifications and applicable Codes. Any reference on the contract documents to 'G.C.,' "GC," 'General Contractor,' 'General Construction Contract,' 'General Trades Contractor' shall be the responsibility of the General Construction Contractor.
- B. Specification Sections:
1. INTRODUCTORY INFORMATION:
    - a. All Sections
  2. BIDDING REQUIREMENTS
    - a. All Sections
  3. CONTRACTING REQUIREMENTS
    - a. All Sections
  4. DIVISION 1 - GENERAL REQUIREMENTS
    - a. All Sections
  5. DIVISION 02 - EXISTING CONDITIONS
    - a. Demolition Sections
  6. DIVISION 03 – CONCRETE
    - a. All Sections
  7. DIVISION 04 – MASONRY
    - a. All Sections
  8. DIVISION 05 - METALS
    - a. All Sections
  9. DIVISION 06 – WOOD, PLASTICS AND COMPOSITES
    - a. All Sections
  10. DIVISION 07 - THERMAL AND MOISTURE PROTECTION
    - a. All Sections
  11. DIVISION 08 – OPENINGS
    - a. All Sections
  12. DIVISION 09 - FINISHES
    - a. All Sections
  13. DIVISION 10 - SPECIALTIES
    - a. All Sections
  14. DIVISION 22 - PLUMBING
    - a. As Applicable
  15. DIVISION 23 - HVAC
    - a. As Applicable
  16. DIVISION 26 - ELECTRICAL
    - a. As Applicable
  17. DIVISION 27 - COMMUNICATIONS
    - a. As Applicable
  18. DIVISION 28 - ELECTRONIC SAFETY AND SECURITY
    - a. As Applicable
  19. DIVISION 31 - EARTHWORK
    - a. All Sections
  20. DIVISION 32 – EXTERIOR IMPROVEMENTS
    - a. All Sections



- C. **Narrative Description of Contract No. 1 - General Construction Contract.** The work of this Contract includes, but shall not be limited to the following items:
1. Provide all fees, Federal, State and Local taxes, inspections, as required to perform the work of this contract.
  2. Provide services identified for the Project Coordinator.
  3. Provide for sweeping and cleaning of parking lots and roadways during the work of this Prime Contract. Provide for removal off site of all waste or excess materials generated by this work.
  4. Provide all quality control testing as required by the Contract documents for the work of this Contract, exclude testing specifically indicated to be provided by the Owner or assigned as work under another Prime Contractor.
  5. Provide temporary access drive, parking, and staging areas. Provide and maintain areas for field offices, laydown areas and temporary construction or access roads as shown or indicated by the Site Utilization Plan. Restore to original condition at completion of the project. The reference to Site Utilization Plan refers to plan to be developed by General Construction Contractor in conjunction with site Plan. Temporary security fencing shall be provided by the General Construction Contractor to enclose areas required for securing construction trailers and storage areas needed by all contracts. Access gates for vehicles and personnel shall be provided for drive-through vehicle access. Fenced enclosure(s) shall not be limited to area indicated on Site Plan. The responsibilities of the General Construction Contractor shall include the requirements described in Section 015000 - Temporary Facilities and Controls, 3.4 "Security and Protection Facilities Installation.
  6. Provide all temporary signage and traffic control measures required by the work of this Contract.
  7. Provide restoration of disturbed lawn areas at the completion of the work. Provide temporary protection of trees and shrubs.
  8. Maintain, clean, and stock supplies for facilities designated for Contractor's use including any use of existing toilet facilities allowed by the owner as per specification section 015000.
  9. Provide and maintain access to building construction area and staging area at all times.
  10. Perform all final cleaning except work specified to be by another trade.
  11. The General Construction Contractor shall perform selective interior and exterior demolition with the exception of work assigned to the Plumbing, HVAC, Electrical Contractors. HVAC, Plumbing, and Electrical demolition will be provided by their respective trades and contracts unless designated otherwise.
  12. Provide all site construction activities scheduled for the project except those specifically assigned to other contracts. Work includes excavation, back-fill, compaction, grading, finish grading, asphalt paving, concrete paving, seeding, extend the sanitary forced main discharge piping from the sewer ejector pump to the existing manhole indicated on the site plan. and other site work and improvements scheduled.
  13. Provide and install site furnishings scheduled, including bollards.
  14. Provide all structural steel framing, steel decking, metal fabrications, and erection scheduled including columns, beams, floor and roof joists, decking, and girders. Provide all primer touch-up and priming of welds as specified.
  15. Provide all necessary steel shop drawings and erection drawings as required per the drawings and specifications.
  16. Provide all concrete work for footings, foundations, floor slabs, including reinforcement and finishing.
  17. Provide all masonry construction for exterior building envelop and for interior work scheduled, including insulation, reinforcement, weather barriers, and other concealed construction for the project.

18. Provide and install all aluminum windows, doors, curtain walls, and glazing including flashings and sealants.
  19. This Contractor shall patch and or repair existing interior walls as shown or scheduled for the work of this project.
  20. Openings and framing in all floor and roof decks shown on the architectural drawings are the responsibility of the General Construction Contract. Openings for other trades not shown on the Architectural drawings are the responsibility of the trade needing the opening.
  21. Provide all modifications and reinforcing to existing steel structure as shown on the architectural drawings or as may be required to install new work of this trade.
  22. Provide and install all new roofing scheduled.
  23. Roofing responsibilities include installing curbs and supports provided under other prime contracts for rooftop equipment scheduled.
  24. Provide all expansion joints and covers not specifically noted to be provided by other prime contracts.
  25. Provide rough carpentry including but not limited to, wood blocking shown or required.
  26. Provide all finish carpentry scheduled for this project.
  27. Provide all scheduled Interior construction, including partitions, doors, interior glazed openings, and fittings.
  28. Interior finishes and finish carpentry.
  29. Miscellaneous items, including painting of mechanical and electrical work.
  30. Provide firestopping for work of this contract and general firestopping not provided for under the other prime contracts. Refer to remainder of prime contract descriptions for work of the other prime contracts.
  31. Provide all hollow metal frames, doors and borrowed lite frames scheduled for the project.
  32. Provide and install all finish hardware specified for openings and for modifying existing installations as scheduled for the work of this project.
  33. Provide painting, staining, clear finish, etc. of walls, ceilings, doors, wood surfaces, etc. as scheduled for the work of this project.
  34. Provide surface preparation, primer touch-up and paint finish for all hollow metal frames, doors, steel lintels or other metal surfaces indicated to receive new finish.
  35. Provide all incidental caulking required for this contract including caulking of interior cracks in the existing building and openings where scheduled for the work of this project.
  36. Patch, clean and paint all new construction and existing walls as shown or specified.
  37. Paint structural and miscellaneous metals exposed to public view as scheduled to be finished.
  38. Provide and install all finish flooring scheduled for the work of this project.
  39. Provide acoustical ceiling systems including hanging wire, wall angle, main runner grid, T-grid, ceiling tiles, edge banding, etc. as scheduled for the work of this project.
  40. Provide extra stock of each type of ceiling tiles, paint, and other materials as specified and deliver to the owner clearly marked and original packaging.
  41. Provide and install all accessories, furnishings, and miscellaneous items identified to be provided under this contract, including display boards, toilet accessories, and interior and exterior signage.
  42. Provide all expansion joint covers and sealants in ceiling-to-ceiling and ceiling to wall applications as required in areas to receive new acoustical ceilings.
  43. Remaining work not specifically assigned or identified as work under other contracts.
- D. Temporary facilities and controls in the General Construction Contract include, but are not limited to, the following:

1. Temporary facilities and controls that are not otherwise specifically assigned to the Plumbing Contract, HVAC Contract, or Electrical Contract.
2. Sediment and erosion control.
3. Unpiped temporary toilet fixtures, wash facilities, and drinking water facilities, including disposable supplies.
4. Project Meeting Trailer and furnishings.
5. Temporary enclosure for building exterior.
6. Project identification and temporary signs.
7. General waste disposal facilities.
8. Temporary fire-protection facilities.
9. Barricades, warning signs, and lights.
10. Site enclosure fence.
11. Security enclosure and lockup.
12. Environmental protection.
13. Restoration of Owner's existing facilities used as temporary facilities.

#### 1.9 PLUMBING CONTRACT

- A. Work of the Plumbing Contract includes, but is not limited to, the following:
1. The Plumbing contractor shall perform selective plumbing demolition; This shall include but not be limited to the removal of existing plumbing fixtures and associated piping. Remove selective domestic water, sanitary and vent piping. The remove of selective compressed air drops and domestic water hose bibs and all associated piping.
  2. The plumbing contractor to provide fully sprinklered system in the Welding building as indicated.
  3. Remove and reinstall existing water cooler with bottle filler and all associated domestic water, sanitary and vent piping.
  4. Provide all indicated above and below grade domestic water, natural gas sanitary and vent piping.
  5. Connect to the general contractor provided roof drain(s) and provide all indicated above and below grade rain water conductor piping.
  6. Provide all requires insulation as specified.
  7. Provide plumbing fixtures and all required associated piping.
  8. Extend domestic cold water piping underground from the main building to the Welding building where indicated on the drawings.
  9. Extend natural gas piping underground from the main building to the Welding building where indicated on the drawings.
  10. Extend fire protection piping underground from the main building to the Welding building where indicated on the drawings.
  11. Provide packaged duplex sewage ejector with exterior wall mounted control panel and all associated underground sanitary and vent piping, control and electrical conduits required to complete the installation.
  12. The plumbing contractor to sawcut all hard surfaces and provide all required excavation needed to trench between the builds to install the natural gas, domestic water, fire protection piping and as required to install the packaged duplex sewage ejector and all associated sanitary and vent pipe indicated on the site plan. The plumbing contractor shall provide all required screening or pea gravel, backfill and compaction of the piping trench as indicated in the specifications. After all trench backfilling and compaction is complete, the G.C. will be responsible to seed all grass areas and to patch all sawcut paved and concrete covered areas where the pipe trench was provided
  13. Provide domestic water heater with mixing valve, hot water recirculation pump, associated piping and required accessories.



14. Provide a horizontal tank type rotary screw air compressor with packaged refrigerated filter dryer, compressed air filter(s), oil water separator, regulator(s), hose reels, quick disconnect fitting(s) and all associated piping indicated on the drawings.
15. Provide all required oxygen, argon, acetylene and acetylene mix welding gas piping indicated on the drawings.

#### 1.10 HVAC CONTRACT

- A. Work of the HVAC Contract includes, but is not limited to, the following:
1. The HVAC contractor shall perform selective HVAC demolition, this shall include but not be limited to; The removal of the indicated HVAC system ventilation ductwork, grilles, registers and diffusers, remove the existing exterior welding smoke collector assembly and all associated interior and exterior ductwork and fume collection arms are to be removed in their entirety, interior and exterior wood dust collection system ductwork and all associated blast gates, hoses and supports in their entirety.
  2. Remove existing ceiling mounted fan coil unit and all associated piping, insulation, hangers and controls in their entirety.
  3. Remove and rotate existing overhead mounted ambient air cleaners where indicated on the drawings and reinstall.
  4. Remove selective roof mounted exhaust fans and cap roof curbs where indicated.
  5. Remove and existing overhead dust collector and all associated ductwork, blast gates, hoses and supports in the entirety. Salvage dust collector, blast gates, hoses and fittings for reuse.
  6. Reinstall salvaged dust collector and associated blast gates, hoses and fittings. Provide spiral ductwork where indicated.
  7. Provide ductwork, grilles, registers and or diffusers where indicated.
  8. Provide rooftop and inline mounted exhaust fans and all associated ductwork where indicated.
  9. Provide rooftop mounted package air handling units, roof curbs and all associated indicated ductwork, grilles, registers and diffusers where indicated.
  10. Provide wall mounted ductless mini-split cooling system where indicated.
  11. Provide overhead mounted ambient air cleaner(s) where indicated.
  12. Provide electric cabinet heaters where indicated.
  13. Provide a gas fired unit heater with concentric venting where indicated.
  14. Provide a fabricated canopy hood, ductwork and exhaust fan where indicated.
  15. Provide an exterior mounted central welding smoke collector system (on the G.C. provide concrete equipment pad) and all associated interior and exterior return air ductwork and registers as well as all indicated interior and exterior exhaust ductwork and welding smoke collection arms.
  16. Provide a plasma cutting downdraft table with removal waste collection drawers, hinged side panels and 10" diameter outlet with motor operated damper.
  17. Provide wall mounted exterior louvers where indicated.
  18. Provide all required supplemental steel not indicated on the structural steel drawings required to support HVAC equipment.
  19. Provide HVAC controls, extend and connect HVAC controls to the existing HVAC control system located in the main building.
  20. Provide all required HVAC testing and system air balancing.

#### 1.11 ELECTRICAL CONTRACT

- A. Work of the Electrical Contract includes, but is not limited to, the following:

1. All electrical demolition: Existing systems include but not limited to: (Clocks, intercom, fire alarm, data, security, access control, and security cameras). Remove Panels, conduit and wiring. Remove existing lighting and power devices as required.
2. Provide new lighting, controls (occupancy sensor, dimmer switches etc.) wiring and conduit.
3. Disconnect all existing 3D Manufacturing and Welding Equipment that is to be relocated from the existing 3D Manufacturing and Welding shops. Provide new wiring, devices, and equipment connections to above mentioned equipment in new 3D Manufacturing and Welding shop spaces.
4. Provide all excavation and backfill, concrete encasement and stone back fill for underground electrical duct bank.
5. Cutting and patching related to electrical work.
6. Provide Extension of Fire Alarm, clock and intercom systems including clocks (low voltage and Power wiring). Provide all new devices, equipment and wiring required.
7. Provide all panelboards, transformers, disconnect switches, time clocks, photo eyes, contactors, etc.
8. Provide all conduit and wiring (low voltage and Power).
9. Provide ceiling tile removal in existing building location to do his work.
10. All required Grounding.
11. Provide Data system devices wiring and equipment connections.
12. Provide Fiber Optic wiring, equipment and connections.
13. Provide Access Control/Security, CCTV, and A-phone devices, equipment and wiring indicated including conduit and wiring (power and low voltage).
14. Provide protection of any existing electrical devices/equipment from dirt and debris.
15. Provide new wiring, conduit, connections to power up HVAC, Plumbing, General, shop equipment and Owner supplied equipment provided under this project.
16. Provide reel drop cord devices and all horizontal and vertical supports required from structure.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011200





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## SECTION 012160 - PREVAILING WAGE RATES

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

- A. The provisions of the Pennsylvania Prevailing Wage Act approved August 15, 1961 (Act No. 442), as amended August 9, 1963 (Act No. 342), and the Regulations issued pursuant thereto are hereby incorporated in and made a part of the General Requirements of the Project. The Secretary of Department of Labor and Industry has predetermined the minimum wage rates, including contributions for employee benefits, which shall be paid to the workmen employed in the performance of the Contract.
- B. The following provisions shall also apply to this contract:
1. Provisions to Apply: The contract provisions shall apply to all work performed on the Contract by the Contractor, and to all work performed on the contract by all Subcontractors.
  2. Subcontracts: The Contractor shall insert in each of his subcontracts all of the stipulations contained in these required provisions and such other stipulations as may be required.
  3. Worker Classifications: No workers may be employed on the Work except in accordance with the classifications set forth in the decision of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in Section 7 of these Regulations shall be followed.
  4. Workers to be Paid Unconditionally: All workers employed or working on the Work shall be paid unconditionally, 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 worker, not less than once a week without deduction or rebate, on any account, either directly or indirectly except authorized deductions, the full amounts due at the time of payment, computed at the rates applicable to the time worked in the appropriate classification. Nothing in the Contract, the Act, or the Regulations shall prohibit the payment of more than the general prevailing minimum wage rates as determined by the Secretary to any worker on public work.
  5. Post Wage Determination: The Contractor and each Subcontractor shall post for the entire period of construction the wage determination decisions of the Secretary, including the effective date of any changes thereof, in a prominent and easily accessible place or places at the site of the work and at such place or places used by them to pay workers their wages. The posted notice of wage rates must contain the following information:
    - a. Name of Project.
    - b. Name of public body for which it is being constructed.
    - c. The crafts and classifications of workers listed in the Secretary's general prevailing minimum wage rate determination for the particular project.
    - d. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.

- 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 and/or Subcontractor are not complying with the Act or these Regulations in any manner whatsoever, 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 as wages for work performed on the public work project. Any worker paid less than the rate specified in the contract shall have a civil right of action for the difference between the wage paid and the wages stipulated in the contract, which right of action must be exercised within six (6) months from the occurrence of the event creating such right.
6. Records: The Contractor and all Subcontractors shall keep an accurate record showing the name, craft and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including employee benefits) to each worker employed by him in connection with the Work and such record must include any deductions from each worker. The record shall be preserved for two years from the date of payment and shall be open at all reasonable hours to the inspection of the public body awarding the contract and to the Secretary or his duly authorized representatives.
7. Apprentices: Apprentices shall be limited to such numbers as shall be in accordance with a bona fide apprenticeship program registered with and approved by the Pennsylvania Apprenticeship and Training Council and only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304) and the Rules and Regulations issued pursuant thereto shall be employed on the Work project. Any worker using the tools of a craft who does not qualify as an apprentice within the provisions of this subsection shall be paid the rate predetermined for journeymen in that particular craft and/or classification.
8. Deductions: Wages shall be paid without any deductions except authorized deductions. Employers not parties to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workers.
- C. Violation: Payment of compensation to workers for work performed on the Work 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 deemed a violation of the Act and these Regulations, regardless of the average hourly earnings resulting therefrom.
- D. Filing Requirements: The Contractor and each Subcontractor shall file a statement each week and a final statement at the conclusion of the Work on the Contract with the contracting agency, under oath, and in form satisfactory to the Secretary, certifying that all workers have been paid wages in strict conformity with the provisions of the contract as prescribed by this Section 3 of these Regulations, or if any wages remain unpaid to set forth the amount of wages due and owing to each worker respectively.

## 1.2 WAGE RATES

- A. The Pennsylvania Prevailing Minimum Wage Rates Schedule, Serial #22-03538 dated 4/21/2022, 14 pages, is attached to this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012160





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

Project Name:	Program Upgrades - Reading Muhlenberg Career & Technology Center
Awarding Agency:	Reading Muhlenberg Career & Technology Center
Contract Award Date:	6/8/2022
Serial Number:	22-03538
Project Classification:	Building
Determination Date:	4/21/2022
Assigned Field Office:	Scranton
Field Office Phone Number:	(570)963-4577
Toll Free Phone Number:	(877)214-3962
Project County:	Berks County

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

<b>Project: 22-03538 - Building</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Asbestos & Insulation Workers	6/26/2017		\$32.00	\$26.51	\$58.51
Asbestos & Insulation Workers	7/2/2018		\$32.80	\$26.76	\$59.56
Asbestos & Insulation Workers	7/2/2019		\$33.80	\$27.26	\$61.06
Asbestos & Insulation Workers	6/29/2020		\$34.80	\$28.01	\$62.81
Asbestos & Insulation Workers	6/28/2021		\$35.80	\$28.26	\$64.06
Asbestos & Insulation Workers	7/27/2022		\$35.80	\$30.01	\$65.81
Asbestos & Insulation Workers	6/26/2023		\$35.80	\$32.01	\$67.81
Asbestos & Insulation Workers	7/1/2024		\$35.80	\$34.06	\$69.86
Boilermaker (Commercial, Institutional, and Minor Repair Work)	3/1/2017		\$28.52	\$18.22	\$46.74
Boilermaker (Commercial, Institutional, and Minor Repair Work)	3/1/2018		\$29.52	\$18.22	\$47.74
Boilermaker (Commercial, Institutional, and Minor Repair Work)	1/1/2019		\$29.26	\$18.48	\$47.74
Boilermakers	1/1/2018		\$46.26	\$33.36	\$79.62
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Boilermakers	1/1/2019		\$45.51	\$34.11	\$79.62
Boilermakers	8/1/2019		\$47.21	\$34.11	\$81.32
Boilermakers	1/1/2021		\$49.32	\$34.90	\$84.22
Boilermakers	1/1/2022		\$50.17	\$35.30	\$85.47
Bricklayer (Pointer, Cleaner, Caulker, Cement Mason, Plasterer, Tile Setter)	5/1/2018		\$29.40	\$20.35	\$49.75
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2017		\$34.11	\$15.19	\$49.30
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2018		\$34.53	\$15.57	\$50.10
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2019		\$35.04	\$15.96	\$51.00
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/3/2020		\$35.64	\$16.36	\$52.00
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2021		\$36.33	\$16.77	\$53.10
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2022		\$38.08	\$17.17	\$55.25
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/30/2023		\$39.98	\$17.17	\$57.15
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/28/2024		\$41.83	\$17.17	\$59.00
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/4/2025		\$43.68	\$17.17	\$60.85
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2017		\$30.05	\$16.05	\$46.10
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2018		\$29.53	\$16.20	\$45.73
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2019		\$30.18	\$16.65	\$46.83
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2020		\$30.88	\$17.10	\$47.98
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2021		\$31.77	\$17.41	\$49.18
Cement Finishers & Plasterers	5/2/2021		\$27.25	\$20.25	\$47.50



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<b>Project: 22-03538 - Building</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Cement Finishers & Plasterers	5/1/2022		\$29.38	\$20.98	\$50.36
Cement Finishers	5/1/2017		\$35.87	\$12.93	\$48.80
Cement Masons	5/1/2019		\$31.00	\$22.68	\$53.68
Cement Masons	5/1/2020		\$30.90	\$20.80	\$51.70
Cement Masons	5/1/2021		\$32.65	\$23.58	\$56.23
Cement Masons	5/1/2022		\$32.90	\$20.85	\$53.75
DockBuilder/ Divers (Building Heavy & Highway)	5/1/2020		\$52.44	\$37.27	\$89.71
DockBuilder/Pile Drivers (Building, Heavy & Highway)	5/1/2018		\$43.45	\$34.47	\$77.92
DockBuilder/Pile Drivers (Building, Heavy & Highway)	5/1/2020		\$43.70	\$37.27	\$80.97
DockBuilder/Pile Drivers/ Diver Tender(Building Heavy & Highway)	5/1/2020		\$43.70	\$37.27	\$80.97
Dockbuilder/Piledriver (Building, Heavy, Highway)	11/1/2017		\$43.45	\$33.22	\$76.67
Dockbuilder/Piledriver (Building, Heavy, Highway)	5/1/2018		\$44.70	\$33.22	\$77.92
Drywall Finisher	5/1/2017		\$27.81	\$18.17	\$45.98
Drywall Finisher	5/1/2019		\$28.58	\$19.64	\$48.22
Drywall Finisher	5/1/2020		\$29.33	\$20.01	\$49.34
Drywall Finisher	5/1/2021		\$29.65	\$20.74	\$50.39
Electricians	9/1/2017		\$34.77	\$21.77	\$56.54
Electricians	9/1/2018		\$36.02	\$22.51	\$58.53
Electricians	9/1/2019	8/31/2020	\$36.77	\$23.53	\$60.30
Electricians	9/1/2020		\$37.77	\$24.07	\$61.84
Electricians	10/18/2021		\$39.02	\$25.08	\$64.10
Electricians	6/1/2022		\$35.25	\$26.31	\$61.56
Electricians	6/1/2023		\$35.25	\$28.41	\$63.66
Electricians	6/1/2024		\$35.25	\$30.51	\$65.76
Electricians	6/1/2025		\$35.25	\$32.50	\$67.75
Electricians	6/1/2026		\$35.25	\$34.43	\$69.68
Elevator Constructor	1/1/2018		\$47.48	\$33.00	\$80.48
Floor Coverer	5/1/2019		\$31.54	\$17.89	\$49.43
Floor Coverer	5/1/2020		\$32.66	\$17.89	\$50.55
Glazier	5/1/2017		\$34.69	\$18.05	\$52.74
Glazier	5/1/2018		\$35.69	\$18.35	\$54.04
Glazier	5/1/2019	4/30/2020	\$35.53	\$20.06	\$55.59
Glazier	5/1/2020	4/30/2021	\$35.53	\$21.51	\$57.04
Glazier	5/1/2021		\$35.53	\$22.86	\$58.39
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2017		\$31.33	\$28.42	\$59.75
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2018		\$32.53	\$28.42	\$60.95
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2019		\$32.76	\$29.88	\$62.64
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2020		\$33.76	\$30.13	\$63.89
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		\$34.01	\$31.13	\$65.14
Laborers (Class 01 - See notes)	5/1/2017		\$21.57	\$15.04	\$36.61

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Laborers (Class 01 - See notes)	5/1/2018	4/30/2019	\$22.07	\$15.59	\$37.66
Laborers (Class 01 - See notes)	5/1/2019	4/30/2020	\$23.02	\$15.92	\$38.94
Laborers (Class 01 - See notes)	5/1/2020		\$23.77	\$16.22	\$39.99
Laborers (Class 01 - See notes)	5/1/2021		\$25.77	\$16.25	\$42.02
Laborers (Class 02 - See notes)	5/1/2017		\$23.57	\$15.04	\$38.61
Laborers (Class 02 - See notes)	5/1/2018		\$24.07	\$15.59	\$39.66
Laborers (Class 02 - See notes)	5/1/2019	4/30/2020	\$25.02	\$15.92	\$40.94
Laborers (Class 02 - See notes)	5/1/2020		\$25.77	\$16.22	\$41.99
Laborers (Class 02 - See notes)	5/1/2020		\$24.07	\$17.92	\$41.99
Laborers (Class 02 - see notes)	5/1/2021		\$27.77	\$16.27	\$44.04
Laborers (Class 03 - See notes)	5/1/2017		\$25.57	\$15.58	\$41.15
Laborers (Class 03 - See notes)	5/1/2018	4/30/2019	\$25.82	\$15.84	\$41.66
Laborers (Class 03 - See notes)	5/1/2019		\$26.87	\$15.94	\$42.81
Laborers (Class 03 - See notes)	5/3/2020		\$27.77	\$16.24	\$44.01
Laborers (Class 03 - See notes)	5/2/2021		\$28.67	\$16.53	\$45.20
Laborers (Class 03 - See notes)	5/1/2022		\$29.62	\$16.24	\$45.86
Laborers (Class 03 - See notes)	4/30/2023		\$30.22	\$16.84	\$47.06
Laborers (Class 04 - See notes)	5/1/2017		\$26.77	\$15.58	\$42.35
Laborers (Class 04 - See notes)	5/1/2018	4/30/2019	\$27.32	\$15.84	\$43.16
Laborers (Class 04 - See notes)	5/1/2019		\$28.37	\$15.94	\$44.31
Laborers (Class 04 - See notes)	5/3/2020		\$29.27	\$16.24	\$45.51
Laborers (Class 04 - See notes)	5/2/2021		\$30.17	\$16.53	\$46.70
Laborers (Class 04 - See notes)	5/1/2022		\$31.12	\$16.24	\$47.36
Laborers (Class 04 - See notes)	4/30/2023		\$31.72	\$16.84	\$48.56
Laborers (Class 05 - See notes)	5/1/2017		\$27.27	\$15.58	\$42.85
Laborers (Class 05 - See notes)	5/1/2018	4/30/2019	\$27.82	\$15.84	\$43.66
Laborers (Class 05 - See notes)	5/1/2019		\$28.87	\$15.94	\$44.81
Laborers (Class 05 - See notes)	5/3/2020		\$29.77	\$16.24	\$46.01
Laborers (Class 05 - See notes)	5/2/2021		\$30.67	\$16.53	\$47.20
Laborers (Class 05 - See notes)	5/1/2022		\$31.62	\$16.24	\$47.86
Laborers (Class 05 - See notes)	4/30/2023		\$32.22	\$16.84	\$49.06
Laborers (Class 06 - See notes)	5/1/2017		\$22.92	\$15.04	\$37.96
Laborers (Class 06 - See notes)	5/1/2018	4/30/2019	\$23.42	\$15.59	\$39.01
Laborers (Class 06 - See notes)	5/1/2019		\$24.37	\$15.92	\$40.29
Laborers (Class 06 - See notes)	5/1/2020		\$24.37	\$16.97	\$41.34
Laborers (Class 06 - See notes)	5/1/2021		\$27.77	\$16.27	\$44.04
Marble Mason	5/1/2017		\$30.14	\$14.75	\$44.89
Marble Mason	5/1/2018		\$30.76	\$15.13	\$45.89
Marble Mason	5/1/2019		\$31.37	\$15.52	\$46.89
Marble Mason	5/1/2020		\$31.97	\$15.92	\$47.89
Marble Mason	5/1/2021		\$32.56	\$16.33	\$48.89
Marble Mason	5/1/2022		\$33.86	\$16.73	\$50.59
Marble Mason	5/1/2023		\$35.81	\$16.73	\$52.54
Marble Mason	5/1/2024		\$37.76	\$16.73	\$54.49

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Marble Mason	5/1/2025		\$39.71	\$16.73	\$56.44
Millwright	7/1/2017		\$36.49	\$18.93	\$55.42
Millwright	5/1/2018		\$37.84	\$19.64	\$57.48
Millwright	5/1/2019		\$39.14	\$20.08	\$59.22
Operators (Building, Class 01 - See Notes)	5/1/2017		\$35.24	\$24.58	\$59.82
Operators (Building, Class 01 - See Notes)	5/1/2018		\$36.78	\$25.03	\$61.81
Operators (Building, Class 01 - See Notes)	5/1/2019		\$36.78	\$27.03	\$63.81
Operators (Building, Class 01 - See Notes)	5/1/2020		\$38.32	\$27.49	\$65.81
Operators (Building, Class 01 - See Notes)	5/1/2021		\$39.87	\$27.94	\$67.81
Operators (Building, Class 01A - See Notes)	5/1/2017		\$37.49	\$25.23	\$62.72
Operators (Building, Class 01A - See Notes)	5/1/2018		\$39.03	\$25.69	\$64.72
Operators (Building, Class 01A - See Notes)	5/1/2019		\$39.03	\$27.69	\$66.72
Operators (Building, Class 01A - See Notes)	5/1/2020		\$40.57	\$28.15	\$68.72
Operators (Building, Class 01A - See Notes)	5/1/2021		\$42.12	\$28.60	\$70.72
Operators (Building, Class 02 - See Notes)	5/1/2017		\$34.96	\$24.49	\$59.45
Operators (Building, Class 02 - See Notes)	5/1/2018		\$36.50	\$24.95	\$61.45
Operators (Building, Class 02 - See Notes)	5/1/2019		\$36.50	\$26.94	\$63.44
Operators (Building, Class 02 - See Notes)	5/1/2020		\$38.05	\$27.39	\$65.44
Operators (Building, Class 02 - See Notes)	5/1/2021		\$39.59	\$27.85	\$67.44
Operators (Building, Class 02A - See Notes)	5/1/2017		\$37.21	\$25.16	\$62.37
Operators (Building, Class 02A - See Notes)	5/1/2018		\$38.75	\$25.61	\$64.36
Operators (Building, Class 02A - See Notes)	5/1/2019		\$38.75	\$27.61	\$66.36
Operators (Building, Class 02A - See Notes)	5/1/2020		\$40.30	\$28.06	\$68.36
Operators (Building, Class 02A - See Notes)	5/1/2021		\$41.84	\$28.52	\$70.36
Operators (Building, Class 03 - See Notes)	5/1/2017		\$32.23	\$23.68	\$55.91
Operators (Building, Class 03 - See Notes)	5/1/2018		\$33.78	\$24.12	\$57.90
Operators (Building, Class 03 - See Notes)	5/1/2019		\$33.78	\$26.13	\$59.91
Operators (Building, Class 03 - See Notes)	5/1/2020		\$35.32	\$26.59	\$61.91
Operators (Building, Class 03 - See Notes)	5/1/2021		\$36.87	\$27.04	\$63.91
Operators (Building, Class 04 - See Notes)	5/1/2017		\$30.33	\$22.12	\$52.45
Operators (Building, Class 04 - See Notes)	5/1/2018		\$32.63	\$23.80	\$56.43
Operators (Building, Class 04 - See Notes)	5/1/2019		\$32.63	\$25.81	\$58.44
Operators (Building, Class 04 - See Notes)	5/1/2020		\$34.18	\$26.26	\$60.44
Operators (Building, Class 04 - See Notes)	5/1/2021		\$35.72	\$26.72	\$62.44
Operators (Building, Class 05 - See Notes)	5/1/2017		\$29.87	\$21.99	\$51.86
Operators (Building, Class 05 - See Notes)	5/1/2018		\$32.18	\$23.69	\$55.87
Operators (Building, Class 05 - See Notes)	5/1/2019		\$32.19	\$25.67	\$57.86
Operators (Building, Class 05 - See Notes)	5/1/2020		\$33.73	\$26.13	\$59.86
Operators (Building, Class 05 - See Notes)	5/1/2021		\$35.27	\$26.59	\$61.86
Operators (Building, Class 06 - See Notes)	5/1/2017		\$29.00	\$21.72	\$50.72
Operators (Building, Class 06 - See Notes)	5/1/2018		\$31.31	\$23.41	\$54.72
Operators (Building, Class 06 - See Notes)	5/1/2019		\$31.31	\$25.41	\$56.72
Operators (Building, Class 06 - See Notes)	5/1/2020		\$32.86	\$25.86	\$58.72
Operators (Building, Class 06 - See Notes)	5/1/2021		\$34.40	\$26.32	\$60.72



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Operators (Building, Class 07A- See Notes)	5/1/2017		\$42.44	\$28.13	\$70.57
Operators (Building, Class 07A- See Notes)	5/1/2018		\$44.29	\$28.68	\$72.97
Operators (Building, Class 07A- See Notes)	5/1/2019		\$44.60	\$30.77	\$75.37
Operators (Building, Class 07A- See Notes)	5/1/2020		\$46.46	\$31.31	\$77.77
Operators (Building, Class 07A- See Notes)	5/1/2021		\$48.31	\$31.86	\$80.17
Operators (Building, Class 07B- See Notes)	5/1/2017		\$42.09	\$28.03	\$70.12
Operators (Building, Class 07B- See Notes)	5/1/2018		\$43.95	\$28.58	\$72.53
Operators (Building, Class 07B- See Notes)	5/1/2019		\$44.26	\$30.66	\$74.92
Operators (Building, Class 07B- See Notes)	5/1/2020		\$46.11	\$31.21	\$77.32
Operators (Building, Class 07B- See Notes)	5/1/2021		\$47.96	\$31.77	\$79.73
Painters Class 1 (see notes)	5/1/2017		\$27.25	\$18.17	\$45.42
Painters Class 1 (see notes)	5/1/2019		\$28.31	\$19.77	\$48.08
Painters Class 1 (see notes)	5/1/2020		\$28.91	\$20.42	\$49.33
Painters Class 1 (see notes)	5/1/2021		\$29.51	\$21.07	\$50.58
Painters Class 2 (see notes)	5/1/2017		\$30.15	\$18.17	\$48.32
Painters Class 2 (see notes)	5/1/2019		\$31.21	\$19.78	\$50.99
Painters Class 2 (see notes)	5/1/2020		\$31.81	\$20.43	\$52.24
Painters Class 3 (see notes)	5/1/2017		\$36.25	\$18.17	\$54.42
Piledrivers	5/1/2021		\$43.73	\$37.99	\$81.72
Plasterers (Use Cement Masons)	5/1/2018		\$29.00	\$21.30	\$50.30
Plasterers	5/1/2017		\$24.23	\$21.38	\$45.61
Plasterers	5/1/2019		\$32.08	\$21.86	\$53.94
Plasterers	5/1/2020		\$32.88	\$22.31	\$55.19
Plasterers	5/1/2020		\$27.48	\$20.83	\$48.31
Plasterers	5/1/2021		\$28.33	\$20.98	\$49.31
plumber	5/1/2019		\$45.92	\$31.72	\$77.64
plumber	8/1/2020		\$47.43	\$32.86	\$80.29
plumber	5/1/2021		\$49.58	\$33.36	\$82.94
Roofers (Composition)	5/1/2017		\$36.15	\$30.22	\$66.37
Roofers (Composition)	5/1/2018		\$37.15	\$31.27	\$68.42
Roofers (Composition)	5/1/2019		\$38.35	\$31.80	\$70.15
Roofers (Composition)	5/1/2020		\$39.50	\$32.30	\$71.80
Roofers (Composition)	5/1/2021		\$40.33	\$33.12	\$73.45
Roofers (Shingle)	5/1/2016		\$25.70	\$19.17	\$44.87
Roofers (Shingle)	5/1/2019		\$28.50	\$20.87	\$49.37
Roofers (Shingle)	5/1/2020		\$29.50	\$21.25	\$50.75
Roofers (Slate & Tile)	5/1/2016		\$28.70	\$19.17	\$47.87
Roofers (Slate & Tile)	5/1/2018		\$30.50	\$20.37	\$50.87
Roofers (Slate & Tile)	5/1/2019		\$31.50	\$20.87	\$52.37
Roofers (Slate & Tile)	5/1/2020		\$32.50	\$21.25	\$53.75
Sheet Metal Workers	6/1/2016		\$33.60	\$33.43	\$67.03
Sheet Metal Workers	6/1/2017		\$33.98	\$35.40	\$69.38
Sheet Metal Workers	6/1/2018		\$34.78	\$36.45	\$71.23
Sheet Metal Workers	6/1/2019		\$36.08	\$37.65	\$73.73

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Sheet Metal Workers	6/1/2020		\$37.26	\$38.97	\$76.23
Sheet Metal Workers	6/1/2021		\$36.08	\$42.65	\$78.73
Sign Makers and Hangars	7/17/2021		\$29.49	\$23.90	\$53.39
Sprinklerfitters	4/1/2017		\$37.40	\$21.74	\$59.14
Sprinklerfitters	4/1/2018		\$38.80	\$22.74	\$61.54
Sprinklerfitters	4/1/2020		\$38.90	\$26.42	\$65.32
Sprinklerfitters	4/1/2021		\$40.33	\$26.94	\$67.27
Sprinklerfitters	4/1/2022		\$42.29	\$27.48	\$69.77
Steamfitters	5/1/2017		\$46.99	\$32.67	\$79.66
Steamfitters	5/1/2019		\$49.93	\$35.82	\$85.75
Steamfitters	5/1/2020		\$51.73	\$37.07	\$88.80
Steamfitters	5/1/2021		\$53.08	\$38.87	\$91.95
Terrazzo Finisher	5/1/2017		\$31.64	\$15.62	\$47.26
Terrazzo Finisher	5/1/2018		\$32.35	\$15.91	\$48.26
Terrazzo Finisher	5/1/2019		\$33.04	\$16.22	\$49.26
Terrazzo Finisher	5/1/2020		\$32.26	\$18.48	\$50.74
Terrazzo Finisher	5/1/2021		\$33.23	\$19.03	\$52.26
Terrazzo Finisher	5/1/2022		\$34.46	\$19.24	\$53.70
Terrazzo Finisher	5/1/2023		\$35.79	\$19.25	\$55.04
Terrazzo Finisher	5/1/2024		\$37.16	\$19.26	\$56.42
Terrazzo Grinder	5/1/2020		\$32.95	\$18.48	\$51.43
Terrazzo Grinder	5/1/2021		\$33.94	\$19.03	\$52.97
Terrazzo Grinder	5/1/2022		\$35.19	\$19.24	\$54.43
Terrazzo Grinder	5/1/2023		\$36.54	\$19.25	\$55.79
Terrazzo Grinder	5/1/2024		\$37.92	\$19.26	\$57.18
Terrazzo Mechanics	5/1/2020		\$32.91	\$20.11	\$53.02
Terrazzo Mechanics	5/1/2021		\$33.83	\$20.78	\$54.61
Terrazzo Mechanics	5/1/2022		\$35.12	\$20.99	\$56.11
Terrazzo Mechanics	5/1/2023		\$36.51	\$21.00	\$57.51
Terrazzo Mechanics	5/1/2024		\$37.94	\$21.01	\$58.95
Terrazzo Setter	5/1/2017		\$30.63	\$18.85	\$49.48
Terrazzo Setter	5/1/2018		\$31.23	\$19.25	\$50.48
Terrazzo Setter	5/1/2019		\$31.81	\$19.67	\$51.48
Tile & Marble Finisher	5/1/2017		\$26.89	\$13.86	\$40.75
Tile & Marble Finisher	5/1/2018		\$27.60	\$14.15	\$41.75
Tile & Marble Finisher	5/1/2019		\$28.29	\$14.46	\$42.75
Tile & Marble Finisher	5/1/2020		\$28.96	\$14.79	\$43.75
Tile & Marble Finisher	5/1/2021		\$29.61	\$15.14	\$44.75
Tile & Marble Finisher	5/1/2022		\$30.96	\$15.49	\$46.45
Tile Setter	5/1/2017		\$30.14	\$14.75	\$44.89
Tile Setter	5/1/2018		\$30.76	\$15.13	\$45.89
Tile Setter	5/1/2019		\$31.37	\$15.52	\$46.89
Tile Setter	5/1/2020		\$31.97	\$15.92	\$47.89
Tile Setter	5/1/2020		\$31.97	\$15.92	\$47.89

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Tile Setter	5/1/2021		\$32.36	\$16.53	\$48.89
Tile Setter	5/1/2022		\$33.86	\$16.73	\$50.59
Tile Setter	5/1/2023		\$35.81	\$16.73	\$52.54
Tile Setter	5/1/2024		\$37.76	\$16.73	\$54.49
Tile Setter	5/1/2025		\$39.71	\$16.73	\$56.44
Truckdriver class 1(see notes)	5/1/2017		\$34.47	\$0.00	\$34.47
Truckdriver class 1(see notes)	5/1/2018		\$35.32	\$0.00	\$35.32
Truckdriver class 1(see notes)	5/1/2019		\$36.12	\$0.00	\$36.12
Truckdriver class 1(see notes)	5/1/2020		\$36.92	\$0.00	\$36.92
Truckdriver class 1(see notes)	5/1/2021		\$37.72	\$0.00	\$37.72
Truckdriver class 2 (see notes)	5/1/2017		\$34.54	\$0.00	\$34.54
Truckdriver class 2 (see notes)	5/1/2018		\$35.39	\$0.00	\$35.39
Truckdriver class 2 (see notes)	5/1/2019		\$36.19	\$0.00	\$36.19
Truckdriver class 2 (see notes)	5/1/2020		\$36.99	\$0.00	\$36.99
Truckdriver class 2 (see notes)	5/1/2021		\$37.79	\$0.00	\$37.79
Truckdriver class 3 (see notes)	5/1/2017		\$35.03	\$0.00	\$35.03
Truckdriver class 3 (see notes)	5/1/2018		\$35.88	\$0.00	\$35.88
Truckdriver class 3 (see notes)	5/1/2019		\$36.68	\$0.00	\$36.68
Truckdriver class 3 (see notes)	5/1/2020		\$37.48	\$0.00	\$37.48
Truckdriver class 3 (see notes)	5/1/2021		\$38.28	\$0.00	\$38.28
Window Film / Tint Installer	6/1/2019		\$24.52	\$12.08	\$36.60



**BUREAU OF LABOR LAW COMPLIANCE  
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<b>Project: 22-03538 - Heavy/Highway</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Carpenter - Chief of Party (Surveying & Layout)	5/1/2019	4/30/2020	\$36.88	\$15.49	\$52.37
Carpenter - Chief of Party (Surveying & Layout)	5/1/2020	4/30/2021	\$39.12	\$15.49	\$54.61
Carpenter - Chief of Party (Surveying & Layout)	5/1/2021		\$41.42	\$15.49	\$56.91
Carpenter - Instrument Person (Surveying & Layout)	5/1/2016		\$27.12	\$13.83	\$40.95
Carpenter - Instrument Person (Surveying & Layout)	5/1/2019	4/30/2020	\$32.07	\$15.49	\$47.56
Carpenter - Instrument Person (Surveying & Layout)	5/1/2020	4/30/2021	\$34.02	\$15.49	\$49.51
Carpenter - Instrument Person (Surveying & Layout)	5/1/2021		\$36.02	\$15.49	\$51.51
Carpenter - Rodman I (Survey & Layout)	5/1/2016		\$21.09	\$13.83	\$34.92
Carpenter - Rodman I (Survey & Layout)	5/1/2019	4/30/2020	\$25.66	\$12.39	\$38.05
Carpenter - Rodman I (Survey & Layout)	5/1/2020	4/30/2021	\$27.22	\$12.39	\$39.61
Carpenter - Rodman I (Survey & Layout)	5/1/2021		\$28.82	\$12.39	\$41.21
Carpenter - Rodman II (Survey & Layout)	5/1/2016		\$18.69	\$13.83	\$32.52
Carpenter	5/1/2019	4/30/2020	\$32.07	\$15.49	\$47.56
Carpenter	5/1/2020	4/30/2021	\$34.02	\$15.49	\$49.51
Carpenter	5/1/2021		\$36.02	\$15.49	\$51.51
Carpenters	6/1/2017		\$30.92	\$14.14	\$45.06
Cement Finishers	1/1/2017		\$27.70	\$20.20	\$47.90
DockBuilder/ Divers (Building Heavy & Highway)	5/1/2020		\$52.44	\$37.27	\$89.71
DockBuilder/Pile Drivers/ Diver Tender(Building Heavy & Highway)	5/1/2020		\$43.70	\$37.27	\$80.97
Electric Lineman	5/29/2017		\$44.22	\$23.94	\$68.16
Electric Lineman	5/28/2018		\$45.25	\$24.94	\$70.19
Electric Lineman	5/27/2019		\$46.32	\$25.97	\$72.29
Electric Lineman	6/1/2020		\$47.42	\$27.04	\$74.46
Electric Lineman	5/31/2021		\$49.22	\$27.36	\$76.58
Electric Lineman	5/30/2022		\$50.28	\$28.47	\$78.75
Electric Lineman	5/29/2023		\$51.40	\$29.62	\$81.02
Electric Lineman	6/3/2024		\$52.80	\$30.61	\$83.41
Electricians	6/1/2022		\$44.46	\$23.06	\$67.52
Electricians	6/1/2023		\$46.49	\$23.06	\$69.55
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2017		\$31.33	\$28.42	\$59.75
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2018		\$32.53	\$28.42	\$60.95
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2019		\$32.76	\$29.88	\$62.64
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2020		\$33.76	\$30.13	\$63.89
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		\$34.01	\$31.13	\$65.14
Iron Workers	7/1/2106		\$31.95	\$27.65	\$59.60
Laborers (Class 01 - See notes)	5/1/2016		\$19.81	\$15.79	\$35.60
Laborers (Class 01 - See notes)	5/1/2017		\$20.36	\$16.29	\$36.65
Laborers (Class 01 - See notes)	5/1/2018		\$20.96	\$16.79	\$37.75
Laborers (Class 01 - See notes)	5/1/2019		\$21.61	\$17.29	\$38.90
Laborers (Class 01 - See notes)	5/1/2020		\$22.41	\$17.69	\$40.10

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<b>Project: 22-03538 - Heavy/Highway</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Laborers (Class 01 - See notes)	5/1/2021		\$23.21	\$18.09	\$41.30
Laborers (Class 01 - See notes)	5/1/2022		\$24.01	\$18.54	\$42.55
Laborers (Class 01 - See notes)	5/1/2023		\$24.81	\$18.99	\$43.80
Laborers (Class 01 - See notes)	5/1/2024		\$25.61	\$19.49	\$45.10
Laborers (Class 02 - See notes)	5/1/2016		\$26.43	\$15.79	\$42.22
Laborers (Class 02 - See notes)	5/1/2017		\$26.98	\$16.29	\$43.27
Laborers (Class 02 - See notes)	5/1/2018		\$27.58	\$16.79	\$44.37
Laborers (Class 02 - See notes)	5/1/2019		\$28.23	\$17.29	\$45.52
Laborers (Class 02 - See notes)	5/1/2020		\$29.03	\$17.69	\$46.72
Laborers (Class 02 - See notes)	5/1/2021		\$29.83	\$18.09	\$47.92
Laborers (Class 02 - See notes)	5/1/2022		\$30.63	\$18.54	\$49.17
Laborers (Class 02 - See notes)	5/1/2023		\$31.43	\$18.99	\$50.42
Laborers (Class 02 - See notes)	5/1/2024		\$32.23	\$19.49	\$51.72
Laborers (Class 03 - See notes)	5/1/2016		\$23.42	\$15.79	\$39.21
Laborers (Class 03 - See notes)	5/1/2017		\$23.97	\$16.29	\$40.26
Laborers (Class 03 - See notes)	5/1/2018		\$24.57	\$16.79	\$41.36
Laborers (Class 03 - See notes)	5/1/2019		\$25.22	\$17.29	\$42.51
Laborers (Class 03 - See notes)	5/1/2020		\$26.02	\$17.69	\$43.71
Laborers (Class 03 - See notes)	5/1/2021		\$26.82	\$18.09	\$44.91
Laborers (Class 03 - See notes)	5/1/2022		\$27.62	\$18.54	\$46.16
Laborers (Class 03 - See notes)	5/1/2023		\$28.42	\$18.99	\$47.41
Laborers (Class 03 - See notes)	5/1/2024		\$29.22	\$19.49	\$48.71
Laborers (Class 04 - See notes)	5/1/2016		\$23.77	\$15.79	\$39.56
Laborers (Class 04 - See notes)	5/1/2017		\$24.32	\$16.29	\$40.61
Laborers (Class 04 - See notes)	5/1/2018		\$24.92	\$16.79	\$41.71
Laborers (Class 04 - See notes)	5/1/2019		\$25.57	\$17.29	\$42.86
Laborers (Class 04 - See notes)	5/1/2020		\$26.37	\$17.69	\$44.06
Laborers (Class 04 - See notes)	5/1/2021		\$27.17	\$18.09	\$45.26
Laborers (Class 04 - See notes)	5/1/2022		\$27.97	\$18.54	\$46.51
Laborers (Class 04 - See notes)	5/1/2023		\$28.77	\$18.99	\$47.76
Laborers (Class 04 - See notes)	5/1/2024		\$29.57	\$19.49	\$49.06
Laborers (Class 05 - See notes)	5/1/2016		\$24.44	\$15.79	\$40.23
Laborers (Class 05 - See notes)	5/1/2017		\$24.99	\$16.29	\$41.28
Laborers (Class 05 - See notes)	5/1/2018		\$25.59	\$16.79	\$42.38
Laborers (Class 05 - See notes)	5/1/2019		\$26.24	\$17.29	\$43.53
Laborers (Class 05 - See notes)	5/1/2020		\$27.04	\$17.69	\$44.73
Laborers (Class 05 - See notes)	5/1/2021		\$27.84	\$18.09	\$45.93
Laborers (Class 05 - See notes)	5/1/2022		\$28.64	\$18.54	\$47.18
Laborers (Class 05 - See notes)	5/1/2023		\$29.44	\$18.99	\$48.43
Laborers (Class 05 - See notes)	5/1/2024		\$30.24	\$19.49	\$49.73
Laborers (Class 06 - See notes)	5/1/2016		\$23.86	\$15.79	\$39.65
Laborers (Class 06 - See notes)	5/1/2017		\$24.41	\$16.29	\$40.70
Laborers (Class 06 - See notes)	5/1/2018		\$25.01	\$16.79	\$41.80
Laborers (Class 06 - See notes)	5/1/2019		\$25.66	\$17.29	\$42.95

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Laborers (Class 06 - See notes)	5/1/2020		\$26.46	\$17.69	\$44.15
Laborers (Class 06 - See notes)	5/1/2021		\$27.26	\$18.09	\$45.35
Laborers (Class 06 - See notes)	5/1/2022		\$28.06	\$18.54	\$46.60
Laborers (Class 06 - See notes)	5/1/2023		\$28.86	\$18.99	\$47.85
Laborers (Class 06 - See notes)	5/1/2024		\$29.66	\$19.49	\$49.15
Laborers (Class 07 - See notes)	5/1/2016		\$24.15	\$15.79	\$39.94
Laborers (Class 07 - See notes)	5/1/2017		\$24.70	\$16.29	\$40.99
Laborers (Class 07 - See notes)	5/1/2018		\$25.30	\$16.79	\$42.09
Laborers (Class 07 - See notes)	5/1/2019		\$25.95	\$17.29	\$43.24
Laborers (Class 07 - See notes)	5/1/2020		\$26.75	\$17.69	\$44.44
Laborers (Class 07 - See notes)	5/1/2021		\$27.55	\$18.09	\$45.64
Laborers (Class 07 - See notes)	5/1/2022		\$28.35	\$18.54	\$46.89
Laborers (Class 07 - See notes)	5/1/2023		\$29.15	\$18.99	\$48.14
Laborers (Class 07 - See notes)	5/1/2024		\$29.95	\$19.49	\$49.44
Laborers (Class 08 - See notes)	5/1/2016		\$24.63	\$15.79	\$40.42
Laborers (Class 08 - See notes)	5/1/2017		\$25.18	\$16.29	\$41.47
Laborers (Class 08 - See notes)	5/1/2018		\$25.78	\$16.79	\$42.57
Laborers (Class 08 - See notes)	5/1/2019		\$26.43	\$17.29	\$43.72
Laborers (Class 08 - See notes)	5/1/2020		\$27.23	\$17.69	\$44.92
Laborers (Class 08 - See notes)	5/1/2021		\$28.03	\$18.09	\$46.12
Laborers (Class 08 - See notes)	5/1/2022		\$28.83	\$18.54	\$47.37
Laborers (Class 08 - See notes)	5/1/2023		\$29.63	\$18.99	\$48.62
Laborers (Class 08 - See notes)	5/1/2024		\$30.43	\$19.49	\$49.92
Operators (Class 02 - All Types of Cranes, Backhoes, Shovels)	5/1/2019		\$33.29	\$25.99	\$59.28
Operators (Heavy, Class 01 - See Notes)	5/1/2016		\$32.16	\$22.64	\$54.80
Operators (Heavy, Class 01 - See Notes)	5/1/2017		\$33.80	\$24.16	\$57.96
Operators (Heavy, Class 01 - See Notes)	5/1/2018		\$35.35	\$24.61	\$59.96
Operators (Heavy, Class 01 - See Notes)	5/1/2019		\$35.35	\$26.61	\$61.96
Operators (Heavy, Class 01 - See Notes)	5/1/2020		\$36.90	\$27.06	\$63.96
Operators (Heavy, Class 01 - See Notes)	5/1/2021		\$38.44	\$27.52	\$65.96
Operators (Heavy, Class 01A - See Notes)	5/1/2017		\$36.05	\$24.82	\$60.87
Operators (Heavy, Class 01A - See Notes)	5/1/2018		\$37.60	\$25.27	\$62.87
Operators (Heavy, Class 01A - See Notes)	5/1/2019		\$37.60	\$27.27	\$64.87
Operators (Heavy, Class 01A - See Notes)	5/1/2020		\$39.14	\$27.73	\$66.87
Operators (Heavy, Class 01A - See Notes)	5/1/2021		\$40.69	\$28.18	\$68.87
Operators (Heavy, Class 02 - See Notes)	5/1/2017		\$33.52	\$24.07	\$57.59
Operators (Heavy, Class 02 - See Notes)	5/1/2018		\$35.07	\$24.52	\$59.59
Operators (Heavy, Class 02 - See Notes)	5/1/2019		\$35.07	\$26.52	\$61.59
Operators (Heavy, Class 02 - See Notes)	5/1/2020		\$36.61	\$26.98	\$63.59
Operators (Heavy, Class 02 - See Notes)	5/1/2021		\$38.16	\$27.43	\$65.59
Operators (Heavy, Class 02A - See Notes)	5/1/2017		\$35.78	\$24.72	\$60.50
Operators (Heavy, Class 02A - See Notes)	5/1/2018		\$37.32	\$25.19	\$62.51
Operators (Heavy, Class 02A - See Notes)	5/1/2019		\$37.32	\$27.19	\$64.51
Operators (Heavy, Class 02A - See Notes)	5/1/2020		\$38.87	\$27.64	\$66.51



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<b>Project: 22-03538 - Heavy/Highway</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Operators (Heavy, Class 02A - See Notes)	5/1/2021		\$40.41	\$28.10	\$68.51
Operators (Heavy, Class 03 - See Notes)	5/1/2017		\$30.60	\$23.21	\$53.81
Operators (Heavy, Class 03 - See Notes)	5/1/2018		\$32.15	\$23.66	\$55.81
Operators (Heavy, Class 03 - See Notes)	5/1/2019		\$32.15	\$25.66	\$57.81
Operators (Heavy, Class 03 - See Notes)	5/1/2020		\$33.69	\$26.12	\$59.81
Operators (Heavy, Class 03 - See Notes)	5/1/2021		\$35.24	\$26.57	\$61.81
Operators (Heavy, Class 04 - See Notes)	5/1/2017		\$29.47	\$22.88	\$52.35
Operators (Heavy, Class 04 - See Notes)	5/1/2018		\$31.01	\$23.32	\$54.33
Operators (Heavy, Class 04 - See Notes)	5/1/2019		\$31.01	\$25.33	\$56.34
Operators (Heavy, Class 04 - See Notes)	5/1/2020		\$32.55	\$25.79	\$58.34
Operators (Heavy, Class 04 - See Notes)	5/1/2021		\$34.10	\$26.24	\$60.34
Operators (Heavy, Class 05 - See Notes)	5/1/2017		\$29.02	\$22.74	\$51.76
Operators (Heavy, Class 05 - See Notes)	5/1/2018		\$30.56	\$23.20	\$53.76
Operators (Heavy, Class 05 - See Notes)	5/1/2019		\$30.56	\$25.20	\$55.76
Operators (Heavy, Class 05 - See Notes)	5/1/2020		\$32.11	\$25.65	\$57.76
Operators (Heavy, Class 05 - See Notes)	5/1/2021		\$33.65	\$26.11	\$59.76
Operators (Heavy, Class 06 - See Notes)	5/1/2017		\$28.14	\$22.49	\$50.63
Operators (Heavy, Class 06 - See Notes)	5/1/2018		\$29.68	\$22.93	\$52.61
Operators (Heavy, Class 06 - See Notes)	5/1/2019		\$29.68	\$24.94	\$54.62
Operators (Heavy, Class 06 - See Notes)	5/1/2020		\$31.23	\$25.39	\$56.62
Operators (Heavy, Class 06 - See Notes)	5/1/2021		\$32.77	\$25.84	\$58.61
Operators (Heavy, Class 07A - See Notes)	5/1/2017		\$40.73	\$27.63	\$68.36
Operators (Heavy, Class 07A - See Notes)	5/1/2018		\$42.58	\$28.18	\$70.76
Operators (Heavy, Class 07A - See Notes)	5/1/2019		\$42.89	\$30.27	\$73.16
Operators (Heavy, Class 07A - See Notes)	5/1/2020		\$44.74	\$30.82	\$75.56
Operators (Heavy, Class 07A - See Notes)	5/1/2021		\$46.59	\$31.37	\$77.96
Operators (Heavy, Class 07B - See Notes)	5/1/2017		\$40.38	\$27.53	\$67.91
Operators (Heavy, Class 07B - See Notes)	5/1/2018		\$42.23	\$28.09	\$70.32
Operators (Heavy, Class 07B - See Notes)	5/1/2019		\$42.54	\$30.17	\$72.71
Operators (Heavy, Class 07B - See Notes)	5/1/2020		\$44.39	\$30.72	\$75.11
Operators (Heavy, Class 07B - See Notes)	5/1/2021		\$46.25	\$31.26	\$77.51
Operators (Highway, Class 01 - See Notes)	5/1/2016		\$32.16	\$22.64	\$54.80
Operators (Highway, Class 01 - See Notes)	5/1/2017		\$32.93	\$23.87	\$56.80
Operators (Highway, Class 01 - See Notes)	5/1/2018		\$34.47	\$24.33	\$58.80
Operators (Highway, Class 01 - See Notes)	5/1/2019		\$34.47	\$26.33	\$60.80
Operators (Highway, Class 01 - See Notes)	5/1/2020		\$37.56	\$25.24	\$62.80
Operators (Highway, Class 01 - See Notes)	5/1/2021		\$39.10	\$25.70	\$64.80
Operators (Highway, Class 01a - See Notes)	5/1/2017		\$35.18	\$24.56	\$59.74
Operators (Highway, Class 01a - See Notes)	5/1/2018		\$36.72	\$25.01	\$61.73
Operators (Highway, Class 01a - See Notes)	5/1/2019		\$36.72	\$27.01	\$63.73
Operators (Highway, Class 01a - See Notes)	5/1/2020		\$39.81	\$25.92	\$65.73
Operators (Highway, Class 01a - See Notes)	5/1/2021		\$41.35	\$26.38	\$67.73
Operators (Highway, Class 02 - See Notes)	5/1/2016		\$30.98	\$22.31	\$53.29
Operators (Highway, Class 02 - See Notes)	5/1/2017		\$31.75	\$23.53	\$55.28

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Operators (Highway, Class 02 - See Notes)	5/1/2018		\$33.30	\$23.98	\$57.28
Operators (Highway, Class 02 - See Notes)	5/1/2019		\$33.29	\$25.99	\$59.28
Operators (Highway, Class 02 - See Notes)	5/1/2020		\$36.38	\$24.90	\$61.28
Operators (Highway, Class 02 - See Notes)	5/1/2021		\$37.93	\$25.35	\$63.28
Operators (Highway, Class 03 - See Notes)	5/1/2016		\$30.28	\$22.10	\$52.38
Operators (Highway, Class 03 - See Notes)	5/1/2017		\$31.06	\$23.32	\$54.38
Operators (Highway, Class 03 - See Notes)	5/1/2018		\$32.59	\$23.80	\$56.39
Operators (Highway, Class 03 - See Notes)	5/1/2019		\$32.59	\$25.79	\$58.38
Operators (Highway, Class 03 - See Notes)	5/1/2020		\$35.69	\$24.69	\$60.38
Operators (Highway, Class 03 - See Notes)	5/1/2021		\$37.23	\$25.16	\$62.39
Operators (Highway, Class 04 - See Notes)	5/1/2016		\$29.82	\$21.98	\$51.80
Operators (Highway, Class 04 - See Notes)	5/1/2017		\$30.60	\$23.20	\$53.80
Operators (Highway, Class 04 - See Notes)	5/1/2018		\$32.14	\$23.66	\$55.80
Operators (Highway, Class 04 - See Notes)	5/1/2019		\$32.14	\$25.66	\$57.80
Operators (Highway, Class 04 - See Notes)	5/1/2020		\$35.23	\$24.57	\$59.80
Operators (Highway, Class 04 - See Notes)	5/1/2021		\$36.77	\$25.03	\$61.80
Operators (Highway, Class 05 - See Notes)	5/1/2016		\$29.31	\$21.83	\$51.14
Operators (Highway, Class 05 - See Notes)	5/1/2017		\$30.08	\$23.06	\$53.14
Operators (Highway, Class 05 - See Notes)	5/1/2018		\$31.63	\$23.51	\$55.14
Operators (Highway, Class 05 - See Notes)	5/1/2019		\$31.63	\$25.51	\$57.14
Operators (Highway, Class 05 - See Notes)	5/1/2020		\$34.72	\$24.42	\$59.14
Operators (Highway, Class 05 - See Notes)	5/1/2021		\$36.26	\$24.87	\$61.13
Operators (Highway, Class 06 - See Notes)	5/1/2016		\$32.40	\$22.70	\$55.10
Operators (Highway, Class 06 - See Notes)	5/1/2017		\$33.17	\$23.94	\$57.11
Operators (Highway, Class 06 - See Notes)	5/1/2018		\$34.71	\$24.39	\$59.10
Operators (Highway, Class 06 - See Notes)	5/1/2019		\$34.71	\$26.39	\$61.10
Operators (Highway, Class 06 - See Notes)	5/1/2020		\$36.25	\$26.85	\$63.10
Operators (Highway, Class 06 - See Notes)	5/1/2021		\$39.33	\$25.78	\$65.11
Operators (Highway, Class 06/A - See Notes)	5/1/2016		\$34.65	\$23.36	\$58.01
Operators (Highway, Class 06/A - See Notes)	5/1/2017		\$35.42	\$24.59	\$60.01
Operators (Highway, Class 06/A - See Notes)	5/1/2018		\$36.96	\$25.05	\$62.01
Operators (Highway, Class 06/A - See Notes)	5/1/2019		\$36.96	\$27.05	\$64.01
Operators (Highway, Class 06/A - See Notes)	5/1/2020		\$40.04	\$25.97	\$66.01
Operators (Highway, Class 06/A - See Notes)	5/1/2021		\$41.58	\$26.43	\$68.01
Operators (Highway, Class 07/A - See Notes)	5/1/2016		\$38.56	\$25.99	\$64.55
Operators (Highway, Class 07/A - See Notes)	5/1/2017		\$39.66	\$27.31	\$66.97
Operators (Highway, Class 07/A - See Notes)	5/1/2018		\$41.52	\$27.84	\$69.36
Operators (Highway, Class 07/A - See Notes)	5/1/2019		\$41.82	\$29.95	\$71.77
Operators (Highway, Class 07/A - See Notes)	5/1/2020		\$45.23	\$28.94	\$74.17
Operators (Highway, Class 07/A - See Notes)	5/1/2021		\$47.08	\$29.49	\$76.57
Operators (Highway, Class 07/B - See Notes)	5/1/2016		\$37.17	\$25.57	\$62.74
Operators (Highway, Class 07/B - See Notes)	5/1/2017		\$38.25	\$26.89	\$65.14
Operators (Highway, Class 07/B - See Notes)	5/1/2018		\$40.10	\$27.44	\$67.54
Operators (Highway, Class 07/B - See Notes)	5/1/2019		\$40.41	\$29.53	\$69.94

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

<b>Project: 22-03538 - Heavy/Highway</b>	<b>Effective Date</b>	<b>Expiration Date</b>	<b>Hourly Rate</b>	<b>Fringe Benefits</b>	<b>Total</b>
Operators (Highway, Class 07/B - See Notes)	5/1/2020		\$43.81	\$28.53	\$72.34
Operators (Highway, Class 07/B - See Notes)	5/1/2021		\$45.66	\$29.08	\$74.74
Painters Class 2 (see notes)	5/1/2020		\$31.81	\$20.43	\$52.24
Painters Class 2 (see notes)	5/1/2021		\$32.41	\$21.08	\$53.49
Painters Class 3 (see notes)	5/1/2019		\$37.31	\$19.78	\$57.09
Painters Class 3 (see notes)	5/1/2020		\$37.91	\$20.43	\$58.34
Painters Class 3 (see notes)	5/1/2021		\$38.51	\$21.08	\$59.59
Piledrivers	5/1/2021		\$43.73	\$37.99	\$81.72
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2017		\$40.98	\$32.53	\$73.51
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2020		\$57.45	\$36.93	\$94.38
Truckdriver class 1(see notes)	5/1/2016		\$33.57	\$0.00	\$33.57
Truckdriver class 1(see notes)	5/1/2017		\$34.47	\$0.00	\$34.47
Truckdriver class 1(see notes)	5/1/2018		\$35.32	\$0.00	\$35.32
Truckdriver class 1(see notes)	5/1/2019		\$36.12	\$0.00	\$36.12
Truckdriver class 1(see notes)	5/1/2020		\$36.92	\$0.00	\$36.92
Truckdriver class 1(see notes)	5/1/2021		\$37.72	\$0.00	\$37.72
Truckdriver class 2 (see notes)	5/1/2016		\$33.64	\$0.00	\$33.64
Truckdriver class 2 (see notes)	5/1/2017		\$34.54	\$0.00	\$34.54
Truckdriver class 2 (see notes)	5/1/2018		\$35.39	\$0.00	\$35.39
Truckdriver class 2 (see notes)	5/1/2019		\$36.19	\$0.00	\$36.19
Truckdriver class 2 (see notes)	5/1/2020		\$36.99	\$0.00	\$36.99
Truckdriver class 2 (see notes)	5/1/2021		\$37.79	\$0.00	\$37.79
Truckdriver class 3 (see notes)	5/1/2016		\$34.13	\$0.00	\$34.13
Truckdriver class 3 (see notes)	5/1/2017		\$35.03	\$0.00	\$35.03
Truckdriver class 3 (see notes)	5/1/2018		\$35.88	\$0.00	\$35.88
Truckdriver class 3 (see notes)	5/1/2019		\$36.68	\$0.00	\$36.68
Truckdriver class 3 (see notes)	5/1/2020		\$37.48	\$0.00	\$37.48
Truckdriver class 3 (see notes)	5/1/2021		\$38.28	\$0.00	\$38.28

## SECTION 012200 - UNIT PRICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
  - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 2. Section 011200 "Multiple Contract Summary" for provisions included in the scope of the prime contracts that are based on unit pricing.
  - 3. Section 012200 "Bid Inclusions" for provisions included in the scope of the prime contracts that are based on unit pricing.

#### 1.3 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

#### 1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 **SCHEDULE OF UNIT PRICES - GENERAL CONSTRUCTION CONTRACT NO. 1:**

- A. Unit Price No. GC-01 - Cutting and Patching of Concrete Slabs-on-Grade:
  - 1. Description: Cutting of existing concrete slabs-on-grade up to 6 inches (152 mm) thick, removal and excavation as required and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents.
  - 2. Unit of Measurement: Square feet of concrete removed.
- B. Unit Price No. GC- 02 - Trench Excavation:
  - 1. Provide cost for authorized additional trench earth excavation including replacement and compaction with engineered fill.
  - 2. Unit of Measurement: Cubic Yard of excavation.
- C. Unit Price No. GC- 03 - Trench Rock Excavation:
  - 1. Provide cost for authorized additional trench rock excavation including replacement and compaction with engineered fill.
  - 2. Unit of Measurement: Cubic yard of excavation
- D. Unit Price No. GC- 04 - Bulk Excavation:
  - 1. Provide unit cost for authorized additional bulk excavation including removal of excavated soils from the site.
  - 2. Unit of Measurement: Cubic yard of excavation
- E. Unit Price No. GC- 05 - Bulk Fill:
  - 1. Provide unit cost for authorized additional bulk fill using approved satisfactory fill materials including compaction and testing of fill materials.
  - 2. Unit of Measurement: Cubic yard
- F. Unit Price No. GC- 06 - Reconstruction / Repair of existing asphalt paving:
  - 1. Description: Provide all labor, equipment, and materials to remove existing asphalt paving, properly prepare the subbase, and install base course and wearing course to align with adjacent roadway surface and composition. Unit price shall include removal of all debris and removed materials. Work shall be in accordance with Section 321216 "Asphalt Paving".
  - 2. Unit of Measurement: Per Square Foot of Asphalt Paving removed.

G. Unit Price No. GC-07 – Provide Steel Beams In lieu of Steel Joists

1. Description: Provide all labor, equipment, and materials to provide steel beams in lieu of steel joists as described on drawings noted Steel Joist Replacement. Work shall be in accordance with Section 051200 “Structural Steel Framing”.
2. Unit of Measurement: Lump Sum

3.2 **SCHEDULE OF UNIT PRICES - PLUMBING CONSTRUCTION CONTRACT NO. 2:**

A. Unit Price No. PC-01 – Steel Natural Gas Piping:

1. Description: Furnish and install 12'-0” above finished floor, 2-inch, sch 40, steel gas piping, including (1) 90° elbow, epoxy paint coating and hangers in accordance with requirements identified in the project documents.
2. Unit of Measurement: 10 Linear Foot.

B. Unit Price No. PC-02 – Domestic Cold-Water Piping:

1. Description: Furnish and install 15'-0” above finished floor, 2-inch, type L, copper piping including hangers and insulation in accordance with requirements identified in the project documents.
2. Unit of Measurement: 10 Linear Foot.

3.3 **SCHEDULE OF UNIT PRICES - HVAC CONSTRUCTION CONTRACT NO. 3:**

A. Unit Price No. HC-01 – Additional Galvanized Sheet Metal Ductwork w/ Acoustical Liner

1. Description: Furnish and install additional galvanized, sheet metal ductwork with insulation, to be installed in a size, shape and location where directed by the Architect. Installation shall include all duct, fittings, and supports for a finished installation 15'-0” above finished floor and in accordance with requirements identified in the project documents.
2. Unit of Measurement: Per 100-pound unit cost.

B. Unit Price No. HC-02 – Wall-Mounted DDC Temperature Sensor:

1. Description: Furnish and install an additional wall mounted DDC temperature sensor in accordance with requirements identified in the project documents.
2. Unit of Measurement: Per device.

3.4 **SCHEDULE OF UNIT PRICES - ELECTRICAL CONSTRUCTION CONTRACT NO. 4:**

- A. Unit Price No. EC-01 – Additional Duplex Receptacle & 20A Circuit:
1. Description: Furnish and install additional duplex receptacle and 20A circuit, including 20A-1P circuit breaker, boxes, faceplates and 150' wire (2#10w/#10grd.) in ¾" conduit overall circuit distance in accordance with requirements identified in the project documents.
  2. Unit of Measurement: Per Additional Receptacle.
- B. Unit Price No. EC-02 – Additional Data Jacks:
1. Description: Furnish and install an additional duplex data jack including two (2) cables including up to 250 feet of wire & accessories in accordance with requirements identified in the project documents.
  2. Unit of Measurement: Per Data Jack.
- C. Unit Price No. EC-03 – Ceiling Mounted Fire Alarm Visual Appliances
1. Description: Furnish and install an additional ceiling mounted fire alarm audio/visual appliance including up to 150 feet of wire in ¾" conduit and accessories in accordance with requirements identified in the project documents.
  2. Unit of Measurement: Per fire alarm audio/visual appliance.
- D. Unit Price No. EC-04 - Additional Twist Lock 60A, Receptacle & 60A, 3-Phase Circuit:
1. Description: Furnish and install additional 60A, 480volt, 3-phase twist lock receptacle and 60A, 480volt, 3-phase circuit, including 60A-3P circuit breaker, box, faceplate and 250 feet of wire (3#4w/#8grd.) in 1" conduit overall circuit distance in accordance with requirements identified in the project documents.
  2. Unit of Measurement: Per Additional Receptacle.

END OF SECTION 012200

**SECTION 012210 – BID INCLUSIONS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Related Sections:
  - 1. Section 012200 "Unit Prices"

**1.3 BID INCLUSIONS**

- A. Each Prime Contractor shall include in their base bid amount, and as a separate line item on the schedule of values, each of the Bid Inclusions designated for their specific contract as indicated below. These Bid Inclusions are to be used as directed by, and signed for, by the Owner or Architect's representative. These hours are to be used for additional selective demolition, repairs, and/or final touch-up of elements designated by the Owner or Architect's representative. These items are not to be used by the Prime Contractor for work identified or scheduled on the project documents or for normal touch-up of the Prime Contractor's work. Hours not used at the end of the project will be credited to the owner.
- B. GENERAL CONSTRUCTION CONTRACT NO. 1:
  - 1. Bid Inclusion #GC-01: 250 Hours General Skilled Labor.
  - 2. Bid Inclusion #GC-02: 50 Painters Hours and 5 Gallons of Paint.
- C. PLUMBING CONSTRUCTION CONTRACT NO. 2:
  - 1. Bid Inclusion #PC-01: 100 Linear feet of 2-inch, schedule 40, steel natural gas piping.
  - 2. Bid Inclusion #PC-02: 100 Linear feet of 2-inch, Type L, copper piping.
  - 3. Bid Inclusion #PC-03: 200 Hours Journeyman Plumber Time.
- D. HVAC CONSTRUCTION CONTRACT NO. 3:
  - 1. Bid Inclusion #HC-01: 500 pounds of galvanized metal duct work.
  - 2. Bid Inclusion #HC-02: 3 additional thermostat devices.
  - 3. Bid Inclusion #HC-03: 100 hours of Journeyman HVAC Time.
- E. ELECTRICAL CONSTRUCTION CONTRACT NO. 4:
  - 1. Bib Inclusion #EC-01: 10 Additional Duplex receptacles and 20A circuit.
  - 2. Bid Inclusion #EC-02: 5 Additional Data Outlets.
  - 3. Bid Inclusion #EC-03: 5 Additional Ceiling Mounted Fire Alarm Audio/Visual Appliances.
  - 4. Bid Inclusion #EC-04: 5 Additional 60A, 3-Phase receptacles and 60A, 3-Phase circuit.
  - 5. Bid Inclusion #EC-05: 200 hours of Journeyman Electricians time.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012210

## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
  - 2. Section 012100 "Allowances" for products selected under an allowance.
  - 3. Section 012300 "Alternates" for products selected under an alternate.
  - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

- b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - h. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- b. Substitution request is fully documented and properly submitted.
- c. Requested substitution will not adversely affect Contractor's construction schedule.
- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500





## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
  - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
- 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 4. Include costs of labor and supervision directly attributable to the change.
  - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
  - 7. Proposal Request Form: Use form acceptable to Architect.

#### 1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

#### 1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

#### 1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.8 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Architect may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600





## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
  - 2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than **seven** days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Owner's name.
    - c. Owner's Project number.
    - d. Name of Architect.

- e. Architect's Project number.
  - f. Contractor's name and address.
  - g. Date of submittal.
2. Arrange schedule of values consistent with format of **AIA Document G703**.
  3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
  5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
  6. Bid Inclusions: Provide a separate line item in the schedule of values for each bid inclusion. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  7. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  8. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  9. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling **five** percent of the Contract Sum and subcontract amount.
  10. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

- B. Payment Application Times: Submit Application for Payment to Architect by the last of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month**.
1. Submit draft copy of Application for Payment **by the 23<sup>rd</sup> of the month** for review by Architect.
- C. Application for Payment Forms: Use **AIA Document G702 and AIA Document G703** as form for Applications for Payment.
1. Other Application for Payment forms proposed by the Contractor may be acceptable to **Architect** and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit **three** signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.



- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from **subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.**
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  4. Products list (preliminary if not final).
  5. Schedule of unit prices.
  6. Submittal schedule (preliminary if not final).
  7. List of Contractor's staff assignments.
  8. Copies of building permits.
  9. Certificates of insurance and insurance policies.
  10. Performance and payment bonds.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706.
  6. AIA Document G706A.

7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



**SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Web-based Project management software package.
  - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
  - 2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.



2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within **15** days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and in prominent location in built facility. Keep list current at all times.

#### 1.5 GENERAL COORDINATION PROCEDURES

A. **Project Coordinator responsibilities shall be provided by the General Construction Contractor** also identified in Section 011200.

B. Coordination: **Each Prime contractor shall cooperate with Project Coordinator** who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Responsibilities of Project Coordinator and All Contracts include:
  - a. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - b. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - c. Make adequate provisions to accommodate items scheduled for later installation.

C. Project Coordinator shall prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities **and direction of Project coordinator** to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to coordination drawings **by multiple contractors** in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

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- b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      - c. Fire-rated enclosures around ductwork.
    - 7. Electrical Work: Show the following:
      - a. Runs of vertical and horizontal conduit **1-1/4 inches (32 mm)** in diameter and larger.
      - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
      - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
      - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
    - 8. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
    - 9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
  - C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
    - 1. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      - b. Prior to receiving drawing files, Contractor shall sign a Release agreement using form prepared by the Architect.
- 1.7 REQUEST FOR INFORMATION (RFI)
- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
    - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
    - 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
  - B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
    - 1. Project name.
    - 2. Owner name.
    - 3. Owner's Project number.
    - 4. Name of Architect.
    - 5. Architect's Project number.

6. Date.
  7. Name of Contractor.
  8. RFI number, numbered sequentially.
  9. RFI subject.
  10. Specification Section number and title and related paragraphs, as appropriate.
  11. Drawing number and detail references, as appropriate.
  12. Field dimensions and conditions, as appropriate.
  13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  14. Contractor's signature.
  15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: **Software-generated form with substantially the same content as indicated above, acceptable to Architect.**
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow three days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within **5** days of receipt of the RFI response.
- 1.8 PROJECT MEETINGS
- A. General: **Schedule and conduct** meetings and conferences at Project site unless otherwise indicated.



1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of **seven** days prior to meeting.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within **three** days of the meeting.
- B. Preconstruction Conference: **Architect will schedule and conduct** a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than **15** days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Preparation of Record Documents.
    - o. Use of the premises **and existing building**.
    - p. Work restrictions.
    - q. Working hours.
    - r. Owner's occupancy requirements.
    - s. Responsibility for temporary facilities and controls.
    - t. Procedures for moisture and mold control.
    - u. Procedures for disruptions and shutdowns.
    - v. Construction waste management and recycling.
    - w. Parking availability.
    - x. Office, work, and storage areas.
    - y. Equipment deliveries and priorities.
    - z. First aid.
    - aa. Security.
    - bb. Progress cleaning.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: **Schedule and conduct** a project closeout conference, at a time convenient to Owner and Architect, but no later than 45 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

- a. Preparation of Record Documents.
  - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
  - c. Procedures for completing and archiving web-based Project software site data files.
  - d. Submittal of written warranties.
  - e. Requirements for preparing operations and maintenance data.
  - f. Requirements for delivery of material samples, attic stock, and spare parts.
  - g. Requirements for demonstration and training.
  - h. Preparation of Contractor's punch list.
  - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
  - j. Submittal procedures.
  - k. Coordination of separate contracts.
  - l. Owner's partial occupancy requirements.
  - m. Installation of Owner's furniture, fixtures, and equipment.
  - n. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Architect shall conduct progress meetings at **biweekly** intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
    - a. Attendance by each Prime Contractor is mandatory at all scheduled Progress Meetings and shall, at a minimum, include the Project Manager and Project Superintendent assigned to the project.
    - b. Additional progress meetings may be scheduled as needed, or as requested by the Owner, to address project and progress issues throughout the course of construction of the work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.

- 4) Status of submittals.
  - 5) Deliveries.
  - 6) Off-site fabrication.
  - 7) Access.
  - 8) Site use.
  - 9) Temporary facilities and controls.
  - 10) Progress cleaning.
  - 11) Quality and work standards.
  - 12) Status of correction of deficient items.
  - 13) Field observations.
  - 14) Status of RFIs.
  - 15) Status of Proposal Requests.
  - 16) Pending changes.
  - 17) Status of Change Orders.
  - 18) Pending claims and disputes.
  - 19) Documentation of information for payment requests.
4. Minutes: Architect will record and distribute the meeting minutes to each party present and to parties requiring information.
  5. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: **Project Coordinator will conduct** Project coordination meetings at **weekly** intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: All Prime Contractors and other entities concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.



- 5) Off-site fabrication.
  - 6) Access.
  - 7) Site use.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of RFIs.
  - 14) Proposal Requests.
  - 15) Change Orders.
  - 16) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Construction schedule updating reports.
  - 4. Site condition reports.
  - 5. Unusual event reports.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
  - 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
  - 3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF file.
- B. Startup construction schedule.
  - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Site Condition Reports: Submit at time of discovery of differing conditions.
- F. Unusual Event Reports: Submit at time of unusual event.

#### 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including phasing, interim milestones and partial Owner occupancy.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review submittal requirements and procedures.
  - 6. Review time required for review of submittals and resubmittals.
  - 7. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 8. Review time required for Project closeout and Owner startup procedures.
  - 9. Review and finalize list of construction activities to be included in schedule.

10. Review procedures for updating schedule.

#### 1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

#### 1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed] to date of Substantial Completion.
  1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
    - a. Securing of approvals and permits required for performance of the Work.
    - b. Temporary facilities.
    - c. Construction of mock-ups, prototypes and samples.
    - d. Owner interfaces and furnishing of items.
    - e. Interfaces with Separate Contracts.
    - f. Regulatory agency approvals.
    - g. Punch list.
  3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.



7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
  
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  1. Phasing: Arrange list of activities on schedule by phase.
  2. Work under More Than One Contract: Include a separate activity for each contract.
  3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
  4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  6. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use-of-premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  
  7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.
    - h. Installation.
    - i. Tests and inspections.
    - j. Adjusting.
    - k. Curing.
    - l. Building flush-out.
    - m. Startup and placement into final use and operation.
    - n. Commissioning.
  
  8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of mechanical installation.

- e. Completion of electrical installation.
    - f. Substantial Completion.
  - E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
  - F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
    - 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
  - G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
    - 1. Unresolved issues.
    - 2. Unanswered Requests for Information.
    - 3. Rejected or unreturned submittals.
    - 4. Notations on returned submittals.
    - 5. Pending modifications affecting the Work and the Contract Time.
  - H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
    - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
    - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
    - 3. As the Work progresses, indicate Final Completion percentage for each activity.
  - I. Recovery Schedule: 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, equipment required to achieve compliance, and date by which recovery will be accomplished.
  - J. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
    - 1. Post copies in Project meeting rooms and temporary field offices.
    - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.8 REPORTS
- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for

Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

- B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
  - 1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Concealed Work photographs.
  - 3. Periodic construction photographs.
- B. Related Requirements:
  - 1. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
  - 2. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each **photograph**. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within **three** days of taking photographs.
  - 1. Submit photos **on a thumb-drive**. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description **in file metadata tag**:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.



1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of **12** megapixels, and at an image resolution of not less than **3200 by 2400** pixels. Use flash in low light levels or backlit conditions.
- B. File Names: Name media files with **date** and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by **Architect**.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work.
- D. Periodic Construction Photographs: Take photographs of work areas **coinciding with the cutoff date associated with each Application for Payment**]. Select vantage points to show status of construction and progress since last photographs were taken.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.2 DEFINITIONS

- A. 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."
- B. 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 as "informational submittals."

#### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list 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 revisions to submittals noted by 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. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
  - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
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 date of fabrication.
  - i. Scheduled dates for installation.
  - j. Activity or event number.

#### 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
  1. Project name.
  2. Date.
  3. Name of Architect.
  4. Name of Contractor.
  5. Name of firm or entity that prepared submittal.
  6. Names of subcontractor, manufacturer, and supplier.
  7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
  8. Category and type of submittal.
  9. Submittal purpose and description.
  10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  11. Drawing number and detail references, as appropriate.
  12. Indication of full or partial submittal.
  13. Location(s) where product is to be installed, as appropriate.
  14. Other necessary identification.
  15. Remarks.
  16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include

relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

- 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- 2. Paper: Prepare submittals in paper form and deliver to Architect.

- 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 Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
- 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, 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 **15** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise 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 **15** days for review of each resubmittal.
- 4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow **15** days for review of each submittal. Submittal will be returned to **Architect** before being returned to Contractor.

- D. 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.

- E. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. 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 unsuitable 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.
  - 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 that show factory-installed wiring.
  - b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: 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.

- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
  5. 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 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.
  6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit **three** sets of Samples. Architect will retain **two** Sample sets; remainder will be returned.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **three** sets of paired units that show approximate limits of variations.

- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. 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.
  4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  2. Field Test Reports: Submit written 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.
  3. 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.
  4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that 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.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit **digitally signed PDF file** of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals 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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a **uniform approval stamp**. Include 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.
  1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.



1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, **and return**.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will **return without review** submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection 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 quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, 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. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Perform preconstruction testing to determine system performance.
  2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.
- 1.4 DELEGATED DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and

systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

**1.5 CONFLICTING REQUIREMENTS**

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified is 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.

**1.6 INFORMATIONAL SUBMITTALS**

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.
- B. **Qualification Data:** For Contractor's quality-control personnel.
- C. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
- D. **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.
- E. **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.
- F. **Reports:** Prepare and submit certified written reports and documents as specified.
- G. **Permits, Licenses, and Certificates:** For Owner's record, 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.



**1.7 CONTRACTOR'S QUALITY-CONTROL PLAN**

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

**1.8 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, telephone number, and email address 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 inspection.
  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.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical 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 of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.
- 1.9 QUALITY ASSURANCE
- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- 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, applying, 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 is similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
  - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. **Testing and Inspecting Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- 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, demonstrate, repair, and perform service on installations 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 Contractor's responsibilities, including the following:
  - 1. Provide test specimens representative of proposed products and construction.
  - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
  - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
  - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
  - 5. When testing is complete, remove test specimens and test assemblies, [and ]mockups; do not reuse products on Project.
  - 6. **Testing Agency Responsibilities:** Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, 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.

1.10 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 inspection 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, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. 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.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations 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 duties of Contractor.



- E. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
  - F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
  - G. **Contractor's Associated Requirements and Services:** Cooperate with agencies and representatives 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 inspection. 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 inspection equipment at Project site.
  - H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
    - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
  - I. **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 and submit with each Application for Payment.
    - 1. **Schedule Contents:** Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
    - 2. **Distribution:** Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
- 1.11 **SPECIAL TESTS AND INSPECTIONS**
- A. **Special Tests and Inspections:** Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
    - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

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 authorities' having jurisdiction reference during normal working hours.
  1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- 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 014000



## SECTION 014200 - REFERENCES

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
  - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  2. AAMA - American Architectural Manufacturers Association; (See FGIA).
  3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
  8. ACI - American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org).
  9. ACPA - American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
  10. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
  11. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
  12. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
  13. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
  14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
  15. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
  16. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
  17. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
  18. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
  19. AITC - American Institute of Timber Construction; [www.plib.org](http://www.plib.org).
  20. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
  21. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  22. AOSA - Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
  23. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
  24. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
  25. API - American Petroleum Institute; [www.api.org](http://www.api.org).
  26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
  27. ARI - American Refrigeration Institute; (See AHRI).
  28. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
  29. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
  30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
  31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).



32. ASME - ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
33. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
34. ASSP - American Society of Safety Professionals (The); [www.assp.org](http://www.assp.org).
35. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
36. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
37. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); [www.avixa.org](http://www.avixa.org).
38. AWEA - American Wind Energy Association; [www.awea.org](http://www.awea.org).
39. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
41. AWPA - American Wood Protection Association; [www.awpa.com](http://www.awpa.com).
42. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
43. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
44. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
45. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
46. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
47. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.org](http://www.bifma.org).
48. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
49. BWF - Badminton World Federation; (Formerly: International Badminton Federation); [www.bissc.org](http://www.bissc.org).
50. CDA - Copper Development Association; [www.copper.org](http://www.copper.org).
51. CE - Conformite Europeenne; [www.ec.europa.eu/growth/single-market/ce-marking](http://www.ec.europa.eu/growth/single-market/ce-marking).
52. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
53. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
54. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
55. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
56. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
57. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
58. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
59. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
60. CPA - Composite Panel Association; [www.compositepanel.org](http://www.compositepanel.org).
61. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
62. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
63. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
64. CSA - CSA Group; [www.csa-group.org](http://www.csa-group.org).
65. CSI - Cast Stone Institute; [www.caststone.org](http://www.caststone.org).
66. CSI - Construction Specifications Institute (The); [www.csiresources.org](http://www.csiresources.org).
67. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
68. CTA - Consumer Technology Association; [www.cta.tech](http://www.cta.tech).
69. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.coolingtechnology.org](http://www.coolingtechnology.org).
70. CWC - Composite Wood Council; (See CPA).
71. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
72. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); [www.decorativehardwoods.org](http://www.decorativehardwoods.org).
73. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
74. ECA - Electronic Components Association; (See ECIA).
75. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
76. ECIA - Electronic Components Industry Association; [www.ecianow.org](http://www.ecianow.org).
77. EIA - Electronic Industries Alliance; (See TIA).
78. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).

79. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
80. EOS/ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
81. ESTA - Entertainment Services and Technology Association; (See PLASA).
82. ETL - Intertek (See Intertek); [www.intertek.com](http://www.intertek.com).
83. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
84. FCI - Fluid Controls Institute; [www.fluidcontrolsintitute.org](http://www.fluidcontrolsintitute.org).
85. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
86. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
87. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).
88. FM Approvals - FM Approvals LLC; [www.fmapprovals.com](http://www.fmapprovals.com).
89. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
90. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; [www.floridarroof.com](http://www.floridarroof.com).
91. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
92. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
93. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
94. GANA - Glass Association of North America; (See NGA).
95. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
96. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
97. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
98. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
99. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
100. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
101. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
102. ICBO - International Conference of Building Officials; (See ICC).
103. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
104. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
105. ICPA - International Cast Polymer Association; [www.theicpa.com](http://www.theicpa.com).
106. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
107. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
108. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
109. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
110. IESNA - Illuminating Engineering Society of North America; (See IES).
111. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
112. IGMA - Insulating Glass Manufacturers Alliance; (See FGIA).
113. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.org](http://www.igshpa.org).
114. II - Infocomm International; (See AVIXA).
115. ILI - Indiana Limestone Institute of America, Inc.; [www.ili.ai.com](http://www.ili.ai.com).
116. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
117. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); [www.isa.org](http://www.isa.org).
118. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
119. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
120. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
121. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
122. ITU - International Telecommunication Union; [www.itu.int](http://www.itu.int).
123. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
124. LMA - Laminating Materials Association; (See CPA).
125. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
126. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).

127. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
128. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
129. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
130. MHI - Material Handling Industry; [www.mhi.org](http://www.mhi.org).
131. MIA - Marble Institute of America; (See NSI).
132. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
133. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
134. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
135. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
136. NACE - NACE International; (National Association of Corrosion Engineers International); [www.nace.org](http://www.nace.org).
137. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
138. NAIMA - North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
139. NALP - National Association of Landscape Professionals; [www.landscapeprofessionals.org](http://www.landscapeprofessionals.org).
140. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
141. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).
142. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
143. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
144. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
145. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
146. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
147. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
148. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
149. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
150. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
151. NFPA - NFPA International; (See NFPA).
152. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
153. NGA - National Glass Association (The); (Formerly: Glass Association of North America); [www.glass.org](http://www.glass.org).
154. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
155. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
156. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
157. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
158. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
159. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
160. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
161. NSI - National Stone Institute; (Formerly: Marble Institute of America); [www.naturalstoneinstitute.org](http://www.naturalstoneinstitute.org).
162. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
163. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
164. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
165. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
166. NWRA - National Waste & Recycling Association; [www.wasterecycling.org](http://www.wasterecycling.org).
167. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
168. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
169. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); [www.plasa.org](http://www.plasa.org).
170. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
171. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
172. RIS - Redwood Inspection Service; [www.redwoodinspection.com](http://www.redwoodinspection.com).
173. SAE - SAE International; [www.sae.org](http://www.sae.org).
174. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).

175. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
176. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
177. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
178. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
179. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
180. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
181. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
182. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
183. SMPTE - Society of Motion Picture and Television Engineers; [www.smpite.org](http://www.smpite.org).
184. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
185. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
186. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
187. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
188. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
189. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
190. STI - Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).
191. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
192. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
193. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
194. TCNA - Tile Council of North America, Inc.; [www.tileusa.com](http://www.tileusa.com).
195. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.tema.org](http://www.tema.org).
196. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
197. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
198. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
199. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
200. TPI - Turfgrass Producers International; [www.turfgrasssod.org](http://www.turfgrasssod.org).
201. TRI - Tile Roofing Institute; [www.tilerroofing.org](http://www.tilerroofing.org).
202. UL - Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).
203. UL LLC - UL LLC; [www.ul.com](http://www.ul.com).
204. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
205. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
206. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
207. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
208. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
209. WCLIB - West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
210. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
211. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
212. WI - Woodwork Institute; [www.wicnet.org](http://www.wicnet.org).
213. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
214. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
  2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
  3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
  4. DOD - Department of Defense; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
  6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
  7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
  8. FG - Federal Government Publications; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
  9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
  11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; [www.eetd.lbl.gov](http://www.eetd.lbl.gov).
  12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  13. SD - Department of State; [www.state.gov](http://www.state.gov).
  14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
  15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
  18. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
  19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.govinfo.gov](http://www.govinfo.gov).
  2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  3. DSCC - Defense Supply Center Columbus; (See FS).
  4. FED-STD - Federal Standard; (See FS).
  5. FS - Federal Specification; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
  6. MILSPEC - Military Specification and Standards; (See DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).



- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
  2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
  3. CDHS; California Department of Health Services; (See CDPH).
  4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx](http://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx).
  5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
  6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
  7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; [www.txforestservation.tamu.edu](http://www.txforestservation.tamu.edu).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.

#### 1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use **without metering and without payment of use charges**. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use **without metering and without payment of use charges**. Provide connections and extensions of services as required for construction operations.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within **15** days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
1. Locations of dust-control partitions at each phase of work.
  2. HVAC system isolation schematic drawing.
  3. Location of proposed air-filtration system discharge.
  4. Waste-handling procedures.
  5. Other dust-control measures.
- E. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Methods used to meet the goals and requirements of the Owner.
  2. Concrete cutting method(s) to be used.
  3. Location of construction devices on the site.
  4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
  5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
  6. Indicate locations of sensitive areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

## 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
1. Use of space in project building, if permitted by the Owner, is only available during summer break when school building will be minimally occupied provided construction activities are not impacted.
- B. Common-Use Meeting Space: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
1. Construction trailer and furnishings for project meetings shall be provided by the General Construction Contract.
  2. Furniture required for Project meetings to include table and chairs adequate to accommodate attendees at scheduled meetings.
    - a. Size accommodations for minimum of 15 at bi-weekly project meetings.
  3. Maintain meeting area separated from construction activities, dirt, and debris.

**2.2 EQUIPMENT**

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

**PART 3 - EXECUTION**

**3.1 TEMPORARY FACILITIES, GENERAL**

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

**3.2 INSTALLATION, GENERAL**

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
    - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities **is not permitted**.
  2. General Construction Contractor shall provide and maintain temporary toilet and wash facilities to accommodate all trades as well as the owner and owner's representatives.
- D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
    - a. If dehumidification is needed to meet manufacturer's requirements for installation or application of materials and finishes, temporary dehumidification shall be provided by the trade responsible for the material or finish installation or application.
  2. Temporary heating and cooling is the responsibility of the HVAC Construction Contractor.
  3. Maintain a min. temperature of 60 F and a max. temperature of 80 F in all areas where finish materials are being installed or stored.
- E.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.



1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Installation of temporary lighting is the responsibility of the Electrical Construction Contractor.

### 3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: **Use designated areas of Owner's existing** parking areas for construction personnel.

D. Storage and Staging: **Use designated areas of Project site** for storage and staging needs.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
  - a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs, so they are legible at all times.

G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.**
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard and replace stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for **48** hours are considered defective and require replacing.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for **48** hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within **48** hours.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
  - 2. Section 012300 "Alternates" for products selected under an alternate.
  - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
  - 4. Section 014200 "References" for applicable industry standards for products specified.
  - 5. Section 01770 "Closeout Procedures" for submitting warranties.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.



1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
  - C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
  - D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
    1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
    2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
  - E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
  - F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.
- 1.4 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
    1. Resolution of Compatibility Disputes between Multiple Contractors:
      - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
      - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
  - B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
    1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
  - a. Name of product and manufacturer.
  - b. Model and serial number.
  - c. Capacity.
  - d. Speed.
  - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

#### 1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

##### B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

##### C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

- a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
  2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
  3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered.
    - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
  4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
  5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

- a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."



1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000



## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
  - 2. Section 013300 "Submittal Procedures" for submitting surveys.
  - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
  - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

#### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### 1.3 PREINSTALLATION MEETINGS

- A. Layout Conference: Conduct conference at Project site.
  - 1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
    - a. Contractor's superintendent.
    - b. Contractor's personnel responsible for performing Project surveying and layout.

- c. Professional engineer responsible for performing site survey serving as basis for Project design.
    - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
    - 3. Review requirements for including layouts on Shop Drawings and other submittals.
    - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- 1.4 INFORMATIONAL SUBMITTALS
  - A. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- 1.5 CLOSEOUT SUBMITTALS
  - A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.
- 1.6 QUALITY ASSURANCE
  - A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
  - B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
    - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
    - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
    - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
    - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
  - C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. 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.
  - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.



3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  2. List of detrimental conditions, including substrates.
  3. List of unacceptable installation tolerances.
  4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
  1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.

6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb, and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of **96 inches (2440 mm)** in occupied spaces and **90 inches (2300 mm)** in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

**3.6 CUTTING AND PATCHING**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.



2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations 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.

### 3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

**3.10 CORRECTION OF THE WORK**

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

**SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
  - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
  - 3. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes the property of each Prime Contractor.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of each contractor.
  - 2. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  - 3. Review waste management requirements for each trade.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
  - 1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  3. Store items in a secure area until installation.
  4. Protect items from damage during transport and storage.
  5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Sale: Not permitted on Project site.
- D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- G. Plumbing Fixtures: Separate by type and size.
- H. Lighting Fixtures: Separate lamps by type and protect from breakage.
- I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL
- A. General: Recycling is not required; however recycling is strongly encouraged.
- 3.4 RECYCLING DEMOLITION WASTE
- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
1. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.



1. Structural Steel: Stack members according to size, type of member, and length.
  2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- G. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- H. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- I. Conduit: Reduce conduit to straight lengths and store by material and size.
- J. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

### 3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  2. Polystyrene Packaging: Separate and bag materials.
  3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
    - a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.
- D. Paint: Seal containers and store by type.

### 3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 017419



## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
  - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

#### 1.4 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.

- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 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.

- 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 other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. 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. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Complete final cleaning requirements.
8. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.



**1.8 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 in accordance with 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.
- 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 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

**1.9 LIST OF INCOMPLETE ITEMS**

- 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.
1. Organize list of spaces in sequential order, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. PDF Electronic File: Architect will return annotated file.

**1.10 SUBMITTAL OF PROJECT WARRANTIES**

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, 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.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit by email to Architect.
- E. Warranties in Paper Form:
  - 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 (215-by-280-mm)** 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.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

## 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 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 not planted, mulched, or paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
  - h. Vacuum and mop concrete.
  - i. 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.
  - j. Remove labels that are not permanent.
  - k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
  - o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - p. Clean strainers.
  - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700



## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Systems and equipment operation manuals.
  - 3. Systems and equipment maintenance manuals.
  - 4. Product maintenance manuals.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
  - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements, including commissioning requirements for verification and compilation of data, for the work in those sections.

#### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:



1. Submitting Manuals for Review: Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
    - a. Digital copies only may be submitted for review prior to final submission of manuals.
  2. Submitting Final Manuals: Submit Digital copy (PDF Format) and two, bound, paper copies for the Owner's records. Provide Digital copy for the Architect's record.
- C. Initial Manual Submittal: Submit draft copy of each manual at least **30** days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### 1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

- b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, **and** subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

#### 1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
  1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

#### 1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
  1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- E. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
1. Emergency Procedures: Include the following, as applicable:
    - a. Instructions on stopping.
    - b. Shutdown instructions for each type of emergency.
    - c. Operating instructions for conditions outside normal operating limits.
    - d. Required sequences for electric or electronic systems.
    - e. Special operating instructions and procedures.
- F. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- G. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.

- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
    - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
    - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
  - G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  - H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
  - I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    - 1. Include procedures to follow and required notifications for warranty claims.
  - J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
    - 1. Do not use original project record documents as part of maintenance manuals.
- 1.9 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
  - B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
  - C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
  - D. Product Information: Include the following, as applicable:
    - 1. Product name and model number.
    - 2. Manufacturer's name.
    - 3. Color, pattern, and texture.
    - 4. Material and chemical composition.
    - 5. Reordering information for specially manufactured products.
  - E. Maintenance Procedures: Include manufacturer's written recommendations and the following:



1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823



## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
  - 2. Section 017300 "Execution" for final property survey.
  - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit **one** set(s) of marked-up record prints.
  - 2. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and **one** set of file prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned Record Prints and one set of file prints.
      - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Record Product Data: Submit **annotated PDF electronic files and directories** of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit **annotated PDF electronic files and directories** of each submittal.

#### 1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or **Construction** Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
  1. Format: Annotated PDF electronic file.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

#### 1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as **annotated PDF electronic file**.
  1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.



1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as **PDF electronic file**.
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

**SECTION 017900 - DEMONSTRATION AND TRAINING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

1.3 CLOSEOUT SUBMITTALS

- A. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.

- c. Systems and equipment maintenance manuals.
  - d. Product maintenance manuals.
  - e. Project Record Documents.
  - f. Identification systems.
  - g. Warranties and bonds.
  - h. Maintenance service agreements and similar continuing commitments.
2. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
3. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
4. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
5. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
6. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.

7. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

#### 1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

#### 1.7 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

#### PART 2 - PRODUCTS

#### PART 3 - EXECUTION

END OF SECTION 017900





## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
- 2. Demolition and removal of selected site elements.
- 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 017300 "Execution" for cutting and patching procedures.
- 3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

#### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and **store**.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

- 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### 1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at **Project site**.

- 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.

- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting existing construction shown to remain, as well as protection of existing floors in routes used for circulation through the building by the demolition contractor.

- C. Schedule of Selective Demolition Activities: Indicate the following:

- 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's 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. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

#### 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
    - a. Equipment and Furniture
- 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. 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.

## 1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP 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. Survey of Existing Conditions: Record existing conditions by use of **preconstruction photographs or video**.

**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 utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

**3.3 PROTECTION**

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
  
- B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  8. Dispose of demolished items and materials promptly. **Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. 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.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition **and cleaned** and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site **and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."**
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

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 024119



## SECTION 032000 - CONCRETE REINFORCING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel reinforcement bars.
  - 2. Welded-wire reinforcement.
- B. Related Requirements:
  - 1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
  - 1. Review the following:
    - a. Special inspection and testing and inspecting agency procedures for field quality control.
    - b. Construction contraction and isolation joints.
    - c. Steel-reinforcement installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Each type of steel reinforcement.
  - 2. Epoxy repair coating.
  - 3. Zinc repair material.
  - 4. Bar supports.
  - 5. Mechanical splice couplers.
  - 6. Structural thermal break insulated connection system.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage **and to avoid damaging coatings on steel reinforcement**.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

## PART 2 - PRODUCTS

### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Galvanized Reinforcing Bars:
  1. Steel Bars: **ASTM A615/A615M, Grade 60 (Grade 420)**, deformed bars.
  2. Zinc Coating: ASTM A767/A767M, **Class I** zinc coated after fabrication and bending.
- E. Steel Bar Mats: ASTM A184/A184M, fabricated from **ASTM A615/A615M, Grade 60 (Grade 420)**, deformed bars, assembled with clips.
- F. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- H. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

### 2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**, plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

- c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
  - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
  - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than **0.0508 inch (1.2908 mm)** in diameter.
- 1. Finish: **Galvanized**.

### 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than **1 inch (25 mm)**, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with **ACI 318 (ACI 318M)**.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or **24 inches (610 mm)**, whichever is greater.
  - 2. Stagger splices in accordance with **ACI 318 (ACI 318M)**.

3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
  - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed **12 inches (305 mm)**.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus **2 inches (50 mm)** for plain wire and **8 inches (200 mm)** for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  1. Place joints perpendicular to main reinforcement.
  2. Continue reinforcement across construction joints unless otherwise indicated.
  3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with **ACI 117 (ACI 117M)**.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a **special inspector** to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
  1. Steel-reinforcement placement.
  2. Steel-reinforcement welding.
- D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 032000

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

- B. Related Requirements:

- 1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
  - 2. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
  - 3. Section 321313 "Concrete Paving" for concrete pavement and walks.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

- a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete Subcontractor.
    - e. Special concrete finish Subcontractor.

- 2. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

#### 1.5 ACTION SUBMITTALS

##### A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
5. Vapor retarders.
6. Joint fillers.
7. Repair materials.

##### B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
8. Intended placement method.
9. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

##### C. Shop Drawings:



1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Architect.

#### 1.6 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
  1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
  3. Do not use frozen materials or materials containing ice or snow.
  4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
  5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
  1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

- 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
- 2. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

- 1. Portland Cement: ASTM C150/C150M, Type I.
- 2. Fly Ash: ASTM C618, Class C or F.

- C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.

- 1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
- 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
- 2. Retarding Admixture: ASTM C494/C494M, Type B.
- 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.

- F. Water: ASTM C94/C94M, potable.

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

- C. Water: Potable or complying with ASTM C1602/C1602M.

- D. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
  - 1. Use on concrete floor slabs not scheduled to receive floor coverings.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

## 2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
3. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

## 2.8 CONCRETE MIXTURES

A. Class: Normal-weight concrete used for footings, grade beams, and tie beams.

1. Exposure Class: ACI 318 (ACI 318M) F0.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
5. Air Content: Maintain within range permitted by ACI301 (ACI 301M)

B. Class: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 (ACI 318M) F0.
2. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
3. Maximum w/cm: 0.50
4. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
5. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm)
6. Air Content: Maintain within range permitted by ACI301 (ACI 301M)

C. Class I: Normal-weight concrete used for interior metal pan stairs and landings:

1. Exposure Class: ACI 318 (ACI 318M) F0.
2. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
3. Maximum w/cm: 0.53.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
5. Maximum Size Aggregate: 1/2 inch (13 mm).
6. Slump Limit: 3 inches (75 mm), plus 1 inch (25 mm) or minus 2 inches (50 mm).

## 2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
1. Daily access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
  4. Security and protection for test samples and for testing and inspection equipment at Project site.

### 3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  2. Face laps away from exposed direction of concrete pour.
  3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
  4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
  5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

### 3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawn Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- 3.6 CONCRETE PLACEMENT
- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.



- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  - 1. If a section cannot be placed continuously, provide construction joints as indicated.
  - 2. Deposit concrete to avoid segregation.
  - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Do not place concrete floors and slabs in a checkerboard sequence.
  - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 3. Maintain reinforcement in position on chairs during concrete placement.
  - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 5. Level concrete, cut high areas, and fill low areas.
  - 6. Slope surfaces uniformly to drains where required.
  - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  - 8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 FINISHING FORMED SURFACES

#### A. As-Cast Surface Finishes:

- 1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1 inch (25 mm).
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
  - e. Apply to concrete surfaces not exposed to public view.
- 2. ACI 301 (ACI 301M) Surface Finish SF-3.0:

- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
- b. Remove projections larger than 1/8 inch (3 mm).
- c. Patch tie holes.
- d. Surface Tolerance: ACI 117 (ACI 117M) Class A.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

### 3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:
  - a. Slabs on Ground:
    - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting

on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm).

- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  - 2. Coordinate required final finish with Architect before application.

### 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
  - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  - 5. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
  3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Begin curing immediately after finishing concrete.
  2. Interior Concrete Floors:
    - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
        - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
        - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
        - b) Cure for not less than seven days.
      - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
        - a) Water.
        - b) Continuous water-fog spray.
    - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
        - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.

### 3.11 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

### 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

### 3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month(s).
  2. Do not fill joints until construction traffic has permanently ceased.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

### 3.14 CONCRETE SURFACE REPAIRS

#### A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete.
  - a. Limit cut depth to 3/4 inch (19 mm).
  - b. Make edges of cuts perpendicular to concrete surface.
  - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
  - d. Fill and compact with patching mortar before bonding agent has dried.
  - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
  - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
  - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

#### D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.
  - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.



3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
  - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
  - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
  - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
  - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.
  - c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  - 1. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 2. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
  - 1. Headed bolts and studs.
  - 2. Verification of use of required design mixture.
  - 3. Concrete placement, including conveying and depositing.
  - 4. Curing procedures and maintenance of curing temperature.
  - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
  - 6. Batch Plant Inspections: On a random basis, as determined by Architect.

- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M:
    - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  6. Compression Test Specimens: ASTM C31/C31M:
    - a. Cast and laboratory cure two sets of two 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
  7. Compressive-Strength Tests: ASTM C39/C39M.
    - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
    - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive

strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  11. Additional Tests:
    - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
      - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
  12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 24 hours of completion of floor finishing and promptly report test results to Architect.

### 3.16 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
  2. Diaper hydraulic equipment used over concrete surfaces.
  3. Prohibit vehicles from interior concrete slabs.
  4. Prohibit use of pipe-cutting machinery over concrete surfaces.
  5. Prohibit placement of steel items on concrete surfaces.
  6. Prohibit use of acids or acidic detergents over concrete surfaces.
  7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
  8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

## SECTION 042000 - UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Lintels.
4. Brick.
5. Mortar and grout materials.
6. Reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Accessories.

- B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation adhered to masonry backup.

- C. Related Requirements:

1. Section 072100 "Thermal Insulation" for cavity wall insulation.
2. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
  - 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
  - 3. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.
  - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Pre-Faced CMUs
  - 2. Clay Face Brick
  - 3. Colored Mortar
- D. Samples for Verification: For each type and color of the following:
  - 1. Prefaced CMUs
  - 2. Clay face brick, in the form of straps of five or more bricks.
  - 3. Pigmented and colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
  - 4. Weep/cavity vents.
  - 5. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Material Certificates: For each type of the following:
  - 1. Masonry units.
    - a. Include material test reports substantiating compliance with requirements.
    - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
    - d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing in accordance with ASTM C67/C67M.
    - e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.



2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

## 1.8 MOCKUPS

A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1219 mm) long by 48 inches (1219 mm) high by full thickness.
  - a. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior wall mockup.
  - b. Include lower corner of window opening, framed with stone trim, at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
  - c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).

- d. Include water-resistive barrier, joint-and-penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
2. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
3. Clean exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
  - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at the time of Substantial Completion.

#### 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 sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.10 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of **24 inches (610 mm)** down both sides of walls, and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
  - C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
    1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
    2. Protect sills, ledges, and projections from mortar droppings.
    3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
    4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
  - D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
    1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
  - E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURES

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C90
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **2800 psi (19.3 MPa)**.
  - 2. Size (Width): Manufactured to dimensions **3/8 inch (10 mm)** less than nominal dimensions.
  - 3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
- C. Decorative CMUs: ASTM C90.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Trenwyth masonry products, Ground Face, Split Face Stripe, and Split Face Accent Squares to match existing building, or comparable products meeting project requirements by one of the following:
    - a. E.P. Henry
    - b. York Building Products.
    - c. Other manufacturers products will be considered with approval by Architect prior to bidding.
  - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **2800 psi (19.3 MPa)**.
  - 3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
  - 4. Pattern and Texture:
    - a. Standard pattern, ground-face finish
    - b. Standard pattern, split-face finish
  - 5. Colors: As selected by Architect from manufacturer's full range.

6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

#### 2.4 LINTELS

- A. General: Provide one of the following.
- B. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- D. Offset Angle Supports: Steel plate brackets anchored to structure, allowing continuous insulation behind shelf angle supporting veneer. Component and anchor size and spacing engineered by manufacturer.

#### 2.5 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).
  1. Products: Subject to compliance with requirements, provide the following:
    - a. New brick is to match face brick on existing buildings in color range, texture, and size.
  2. Grade: SW
  3. Type: FBS
  4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 6200 psi (42.75 MPa).
  5. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.

6. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
7. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from 10 ft. (3 m) or have a history of successful use in Project's area.
8. Size (Actual Dimensions): Match size of face brick on existing building.
9. Application: Use where brick is exposed unless otherwise indicated.
10. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
11. Color and Texture: Match face brick on existing buildings.

## 2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
  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. Davis Colors.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. Lanxess Corporation.
    - d. Solomon Colors Inc.
- E. Colored Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, mortar pigments, and admixtures and complying with ASTM C1714/C1714M.
  1. Colored Portland Cement-Lime Mix:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Essroc.
      - 2) Lafarge North America Inc.
      - 3) Lehigh Hanson; Heidelberg Cement Group.



- b. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  - c. Pigments shall not exceed 10 percent of portland cement by weight.
- F. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than **1/4 inch (6.4 mm)** thick, use aggregate graded with 100 percent passing the **No. 16 (1.18-mm)** sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C404.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Euclid Chemical Company (The); an RPM company.
    - b. GCP Applied Technologies Inc.
- I. Water: Potable.

## 2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, **Grade 60 (Grade 420)**.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from **0.148-inch (3.77-mm)** steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Mill- galvanized carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: **0.148-inch (3.77-mm)** diameter.
  - 4. Wire Size for Cross Rods: **0.148-inch (3.77-mm)** diameter.
  - 5. Wire Size for Veneer Ties: **0.148-inch (3.77-mm)** diameter.
  - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than **16 inches (406 mm)** o.c.
  - 7. Provide in lengths of not less than **10 ft. (3 m)**, with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least **1-1/2 inches (38 mm)** into veneer but with at least a **5/8-inch (16-mm)** cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
  2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
  3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
  4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, **G60 (Z180)** zinc coating.
  5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
  6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
  7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
  8. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than **4 inches (100 mm)** wide.
1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than **2 inches (51 mm)** long for masonry constructed from solid units.
  2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of **1-1/4 inches (32 mm)**.
  3. Wire: Fabricate from **3/16-inch- (4.76-mm-)** diameter, hot-dip galvanized steel wire.
- D. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a **100 lbf (445 N)** load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of **1/16 inch (1.6 mm)**.
  2. Fabricate sheet metal anchor sections and other sheet metal parts from **0.0785-inch- (1.99-mm-)** thick steel sheet, galvanized after fabrication.
  3. Fabricate wire ties from **0.187-inch- (4.76-mm-)** diameter, hot-dip galvanized-steel wire unless otherwise indicated.
  4. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.
    - 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) FERO Corporation.
      - 2) Hohmann & Barnard, Inc.
      - 3) PROSOCO, Inc.
      - 4) Wire-Bond.

- E. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.
  - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

## 2.9 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
  - 2. Fabricate continuous flashings in sections 96 inches (2438 mm) long minimum, but not exceeding 12 ft. (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
  - 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
  - 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  - 5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
  - 6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6.4 mm) to form a stop for retaining sealant backer rod.
  - 7. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
  - 8. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6.4 mm) to form a stop for retaining sealant backer rod.
  - 9. Solder metal items at corners.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
  - 1. Copper-Laminated Flashing: 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
  - 2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.02 mm).
    - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

- C. Application: Unless otherwise indicated, use the following:
  - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
  - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge unless indicated on drawings to provide a sealant stop.
  - 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- E. Termination Bars for Flexible Flashing: Aluminum bars 0.075 inch by 1 inch (1.90 mm by 25 mm).

## 2.10 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use the following unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
    - 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) Advanced Building Products Inc.
      - 2) Heckmann Building Products, Inc.
      - 3) Hohmann & Barnard, Inc.
      - 4) Mortar Net Solutions.
      - 5) Wire-Bond.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Mortar Deflector: Strips, full depth of cavity high, with dovetail-shaped notches that prevent clogging with mortar droppings.

- 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) Advanced Building Products Inc.
  - 2) Hohmann & Barnard, Inc.
  - 3) Keene Building Products.
  - 4) Mortar Net Solutions.
  - 5) Wire-Bond.
- F. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc.

## 2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
  - 3. For exterior masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
  - 4. For reinforced masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
  - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For masonry below grade or in contact with earth, use Type M.
  - 2. For reinforced masonry, use Type S.
  - 3. For mortar parge coats, use Type S.
  - 4. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

5. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
  1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Mix to match Architect's sample.
  3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Clay face brick.
    - c. Cast-stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  1. Mix to match Architect's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Clay face brick.
    - c. Cast-stone trim units.
- F. Grout for Unit Masonry: Comply with ASTM C476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
  3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured in accordance with ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than **1/16 inch (1.6 mm)** except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch (3.2 mm)**, with a maximum thickness limited to **1/2 inch (13 mm)**.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than **1/8 inch (3.2 mm)**.
3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch (10 mm)** or minus **1/4 inch (6.4 mm)**.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch (3.2 mm)**. [Do not vary from adjacent bed-joint and head-joint thicknesses by more than **1/8 inch (3.2 mm)**.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16 inch (1.6 mm)** from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal **4-inch (102-mm)** horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than **4 inches (102 mm)**. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch (102-mm)** horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout **24 inches (610 mm)** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide **1/2-inch (13-mm)** clearance between end of anchor rod and end of tube. Space anchors **48 inches (1219 mm)** o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

#### A. Lay CMUs and hollow brick as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

#### B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

#### C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

#### D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer **3/4 inch (19 mm)** or more in width.

#### E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

#### F. Cut joints flush where indicated to receive waterproofing, cavity wall insulation or air barriers unless otherwise indicated.

### 3.6 CAVITY WALLS

#### A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
    - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
  2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
    - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
    - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
  3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.
  4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (305 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.
1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.
- 3.7 ANCHORED MASONRY VENEERS
- A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Embed connector sections and continuous wire in masonry joints.
  2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

3. Space anchors as indicated, but not more than 18 inches (457 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
- B. Provide not less than 2 inches (51 mm) of airspace between back of masonry veneer and face of insulation.
  1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### 3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
  1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (102 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  2. Build flanges of factory-fabricated, expansion-joint units into masonry.
  3. Build in compressible joint fillers where indicated.
  4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).
  1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.9 LINTELS

- A. Install steel lintels where indicated.

- B. Provide concrete, masonry or offset angle support lintels where indicated and where openings of more than **12 inches (305 mm)** for brick-size units and **24 inches (610 mm)** for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of **8 inches (203 mm)** at each jamb unless otherwise indicated.

### 3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of **8 inches (203 mm)**, and through inner wythe to within **1/2 inch (13 mm)** of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately **2 inches (51 mm)** on interior face.
  - 3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of **8 inches (203 mm)**, and **1-1/2 inches (38 mm)** into the inner wythe.
  - 4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least **8 inches (203 mm)**; with upper edge tucked under water-resistive barrier, lapping at least **4 inches (102 mm)**. Fasten upper edge of flexible flashing to sheathing through termination bar.
  - 5. At lintels and shelf angles, extend flashing **6 inches (152 mm)** minimum, to edge of next full unit at each end. At heads and sills, extend flashing **6 inches (152 mm)** minimum, to edge of next full unit and turn ends up not less than **2 inches (51 mm)** to form end dams.
  - 6. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than **1-1/2 inches (38 mm)** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 7. Install metal drip edges and sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch (13 mm)** back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch (13 mm)** back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  - 10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall.



Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
  - 1. Use specified weep/cavity vent products to form weep holes.
  - 2. Space weep holes **24 inches (610 mm)** o.c. unless otherwise indicated.
  - 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- F. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- G. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
  - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.11 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than **60 inches (1524 mm)**.

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

- B. Inspections: Special inspections in accordance according to requirements and compliance with local building code officials and PA UCC/ IBC 2018.

### 3.13 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of **3/4 inch (19 mm)**. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of **1/8 inch per foot (3.2 mm per 305 mm)**. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

### 3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
  - 7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches (102 mm) in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches (457 mm) of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000



## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
3. Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.

#### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

#### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

**A. Product Data:**

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Galvanized-steel primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

**B. Shop Drawings: Show fabrication of structural-steel components.**

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

**1.6 INFORMATIONAL SUBMITTALS**

**A. Qualification Data: For Installer, fabricator, and testing agency.**

**B. Welding certificates.**

**C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.**

**D. Mill test reports for structural-steel materials, including chemical and physical properties.**

**E. Product Test Reports: For the following:**

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

**F. Survey of existing conditions.**

**G. Source quality-control reports.**

**H. Field quality-control reports.**



1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
  - 1. Weight Class: Extra strong.
  - 2. Finish: Black except where indicated to be galvanized.
- F. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- G. Steel Forgings: ASTM A668/A668M.
- H. Welding Electrodes: Comply with AWS requirements.

## 2.2 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip or mechanically deposited zinc coating.
  - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.
- C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.3 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
  - 1. Configuration: Hooked.
  - 2. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
  - 3. Plate Washers: ASTM A36/A36M carbon steel.
  - 4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
  - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
  - 1. Nuts: ASTM A563 (ASTM A563M) hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
  - 4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- C. Threaded Rods: ASTM A36/A36M.
  - 1. Nuts: ASTM A63 (ASTM A563M) hex carbon steel.
  - 2. Washers: ASTM A36/A36M carbon steel.
  - 3. Finish: Plain, or Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.4 PRIMER

- A. Steel Primer:
  - 1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

**2.5 SHRINKAGE-RESISTANT GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

**2.6 FABRICATION**

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
  - 4. Mark and match-mark materials for field assembly.
  - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

**2.7 SHOP CONNECTIONS**

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

## 2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 4. Galvanized surfaces unless indicated to be painted.
  - 5. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  - 1. SSPC-SP 3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - a. Liquid Penetrant Inspection: ASTM E165/E165M.
  - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  - c. Ultrasonic Inspection: ASTM E164.
  - d. Radiographic Inspection: ASTM E94/E94M.
4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
  - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.



- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
  - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94/E94M.
  - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
  - 4. Testing Agency shall perform tests and inspections as required for compliance with local Building Code Authority.

3.7 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 051200

## SECTION 052100 - STEEL JOIST FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. Long Span steel joists.
3. Steel joist accessories.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
2. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

#### 1.2 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer**.

B. Welding certificates.

C. Manufacturer certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- E. Mill Certificates: For each type of bolt.
- F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- G. Field quality-control reports.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications.
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

#### 1.6 SEQUENCING

- A. Deliver steel bearing plates to be built into **masonry** construction.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. [Canam Buildings US Inc.; Canam Group Inc.](#)
  - 2. [Goeder-Henrichsen Co.](#)
  - 3. [New Millennium Building Systems, LLC.](#)
  - 4. [Structures of U.S.A., Inc.](#)
  - 5. [Valley Joist.](#)
  - 6. [Vulcraft/Verco Group; a division of Nucor Corp.](#)

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
  - 1. Design special joists to withstand design loads with live-load deflections no greater than the following:
    - a. Roof Joists: Vertical deflection of **1/240** of the span.

#### 2.3 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: **K-series steel joists.**

2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
  3. Provide holes in chord members for connecting and securing other construction to joists.
  4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
  5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
  6. Do not camber joists.
  7. Camber joists **according to SJI's "Specifications."** unless **indicated otherwise on Drawings.**
  8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches (1:48).**
- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements **as follows:**
1. Joist Type: **LH-series long-span steel joists.**
  2. End Arrangement: **Underslung.**
  3. Top-Chord Arrangement: **Parallel.**
  4. Provide holes in chord members for connecting and securing other construction to joists.
  5. Camber long-span steel joists **according to SJI's "Specifications."** unless **indicated otherwise on Drawings..**
  6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches (1:48).**

## 2.4 PRIMERS

- A. Primer:
1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## 2.5 STEEL JOIST ACCESSORIES

- A. Bridging:
1. Provide bridging anchors and number of rows of **horizontal or diagonal** bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings.
- C. Welding Electrodes: Comply with AWS standards.
- D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by **hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3**.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than **1 mil (0.025 mm)** thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications[, joist manufacturer's written instructions, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
  - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel **bearing plates and framework**. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.



3.3 REPAIRS

A. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories.
  - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will **Engage** a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100



## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - a. Power-actuated mechanical fasteners.

#### 1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ASC Steel Deck; ASC Profiles, LLC.
  - 2. Canam Buildings US Inc.; Canam Group Inc.
  - 3. Cordeck.
  - 4. New Millennium Building Systems, LLC.
  - 5. Roof Deck, Inc.
  - 6. Verco Decking, Inc.; a Nucor company.
  - 7. Vulcraft Group; Division of Nucor Corp.
  - 8. Vulcraft/Verco Group; a division of Nucor Corp.
- B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
  - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), **Grade 33 (230)** zinc coating.
  - 2. Deck Profile: **As indicated on drawings.**
  - 3. Profile Depth: **As indicated on drawings.**
  - 4. Span Condition: **Triple span or more.**
  - 5. Side Laps: **Overlapped or interlocking seam at Contractor's option.**

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, **No. 10 (4.8-mm)** minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of **33,000 psi (230 MPa)**, not less than **0.0359-inch (0.91-mm)** design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

### 3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than **1-1/2 inches (38 mm)** long, and as follows:
  - 1. Weld Diameter: **5/8 inch (16 mm)**, nominal.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds **18 inches (460 mm) apart, maximum** except where indicated otherwise on drawings.
  - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or **36 inches (1 m)**, and as follows:
  - 1. Mechanically fasten with self-drilling, **No. 10 (4.8-mm-)** diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **1-1/2 inches (38 mm)**, with end joints as follows:
  - 1. End Joints: **Lapped 2 inches (50 mm) minimum or butted at Contractor's option.**

### 3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will **Engage** a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.
  - 2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 053100



## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Platform joist framing.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Cold-formed steel framing materials.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. CEMCO: California Expanded Metal Products Co.
  - 2. ClarkDietrich Building Systems.
  - 3. MarinoWARE.

4. [MRI Steel Framing, LLC.](#)
5. [United Metal Products, Inc.](#)

## 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  1. Design Loads: **15 psf Dead Load and 125 psf Live Load.**
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and **ASTM C955.**

## 2.3 PLATFORM JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, **punched with standard holes**, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: **0.0677 inch (1.72 mm).**
  2. Flange Width: **2 inches (51 mm)**, minimum.
  3. Section Properties:
    - a. Gross Properties
      - 1) Moment of Inertia about x-axis: 8.14
      - 2) Section modulus about x-axis: 2.04
      - 3) Radius about x-axis: 3.00
      - 4) Moment of inertia about y-axis: 0.435
      - 5) Radius about y-axis: 0.692
    - b. Effective Properties
      - 1) Deflection moment of inertia about x-axis: 8.14
      - 2) Section modulus about x-axis: 1.96
      - 3) Allowable moment based on local buckling: 65.2
      - 4) Allowable moment based on distortional buckling: 54.7
      - 5) Allowable strong axis shear away from punchout: 4220
      - 6) Allowable strong axis shear at punchout: 3367
    - c. Torsional Properties
      - 1) Saint-Venant torsion constant (x 1000): 1.54
      - 2) Torsional warping constant: 5.71
      - 3) Distance from shear center to centroid along principal x-axis: -1.25
      - 4) Distance from shear center to mid-plane web: 0.796
      - 5) Polar radius of gyration about shear center: 3.32
      - 6) Limit of unbraced length below which lateral-torsional buckling is not considered: 38.4

## 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, for a complete installation.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

## 2.6 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
  - 3. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of **1/8 inch in 10 feet (1:960)** and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of **1/8 inch (3 mm)**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.3 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet (1:960)** and as follows:
  - 1. Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Shelf angles.
3. Metal ladders.
4. Metal ships' ladders.
5. Miscellaneous steel trim.
6. Metal bollards.
7. Metal downspout boots.
8. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

#### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:
  - 1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
  - 2. Shelf angles.
  - 3. Metal ladders.
  - 4. Metal ships' ladders and pipe crossovers.
  - 5. Metal bollards.
  - 6. Loose steel lintels.
- B. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates:
  - 1. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
  - 2. Welding certificates.
  - 3. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- B. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.



- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- D. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- G. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
- H. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- I. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in

concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

#### 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch (1 mm)** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

## 2.7 SHELF ANGLES

- A. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- B. Galvanize shelf angles located in exterior walls.

## 2.8 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3.
- B. Steel Ladders:
  - 1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
  - 2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch- (19-mm-) diameter, steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
  - 6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
  - 7. Galvanize exterior ladders, including brackets.

2.9 METAL SHIPS' LADDERS

- A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
  - 1. Treads are not to be less than **5 inches (127 mm)** exclusive of nosing or less than **8-1/2 inches (216 mm)** including the nosing, and riser height is not to be more than **9-1/2 inches (241 mm)**.
  - 2. Fabricate ships' ladders, including railings from steel.
  - 3. Fabricate treads and platforms from abrasive-surface floor plate.
  - 4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Prime exterior miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.11 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
- B. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with **1/4-inch- (6.4-mm-)** thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than **8 inches (200 mm)** deep and **3/4 inch (19 mm)** larger than OD of bollard.
- C. Prime steel bollards with primer specified in Section 099600 "High-Performance Coatings."

2.12 METAL DOWNSPOUT BOOTS

- 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. J.R. Hoe & Sons Inc.
  - 2. Neenah Foundry Company.
- B. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- C. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

2.13 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.

2.14 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than **8 inches (200 mm)** unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.15 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with primers specified in Section 099600 "High-Performance Coatings" are indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.



3.3 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

3.4 INSTALLATION OF METAL LADDERS

- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
- B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.5 INSTALLATION OF METAL SHIPS' LADDERS

- A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

3.6 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.7 INSTALLATION OF METAL BOLLARDS

- A. Anchor bollards in concrete in formed or core-drilled holes not less than **42 inches (1050 mm)** deep and **3/4 inch (19 mm)** larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately **1/8 inch (3 mm)** toward bollard.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.8 INSTALLATION OF METAL DOWNSPOUT BOOTS

- A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
- B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.9 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.10 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

**SECTION 055113 - METAL PAN STAIRS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Preassembled steel stairs with concrete-filled treads.
  - 2. Steel tube railings and guards attached to metal stairs.
  - 3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, railings, and guards.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
  - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.
- E. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
  - 3. Include plan at each level.
  - 4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.
- F. Delegated Design Submittal: For stairs, railings, and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the Commonwealth of Pennsylvania.
- B. Welding certificates.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings and guards, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
  - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.

## 2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

## 2.3 FASTENERS

- A. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Handrail Wall Brackets: Cast nickel-silver, center of rail 2-1/2 inches (63.5 mm) from face of wall.
- B. Welding Electrodes: Comply with AWS requirements.

- C. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- E. Prefilled Concrete Treads:
  - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa) and maximum aggregate size of 1/2 inch (13 mm) unless otherwise indicated.
  - 2. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
    - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
  - 1. Disassemble units only as necessary for shipping and handling limitations.
  - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.



4. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 - Completely sanded joint with some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  2. Locate joints where least conspicuous.
  3. Fabricate joints that will be exposed to weather in a manner to exclude water.
  4. Provide weep holes where water may accumulate internally.

## 2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Stringers: Fabricate of steel channels or as indicated on Drawings].
    - a. Stringer Size: As indicated on Drawings.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Shop primed.
  2. Platforms: Construct of steel plate or steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Shop primed.
  3. Weld stringers to headers; weld framing members to stringers and headers.
  4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than **0.067 inch (1.7 mm)**.
1. Steel Sheet, Uncoated: Cold-rolled steel sheet.
  2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  4. Shape metal pans to include nosing integral with riser.
  5. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
  6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: **1-5/8-inch- (41-mm-)** diameter top and bottom rails and **1-1/2-inch- (38-mm-)** square posts.
  2. Intermediate Rails Infill: **1-5/8-inch- (41-mm-)** diameter intermediate rails spaced less than **21 inches (533 mm)** clear.
- B. Welded Connections: Fabricate railings and guards with welded connections.
1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  2. Weld all around at connections, including at fittings.
  3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  4. Obtain fusion without undercut or overlap.
  5. Remove flux immediately.
  6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 - Completely sanded joint, some undercutting and pinholes are okay as shown in NAAMM AMP 521.
- C. Form changes in direction of railings and guards as follows:
1. By inserting prefabricated flush-elbow fittings.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing and guard members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
1. Close ends of returns unless clearance between end of rail and wall is **1/4 inch (6 mm)** or less.
- G. Connect posts to stair framing by direct welding unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  2. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
  3. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides **1-1/2-inch (38-mm)** clearance from inside face of handrail to finished wall surface.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
  1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
  1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
  1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
    - a. Clean bottom surface of plates.
    - b. Set plates for structural members on wedges, shims, or setting nuts.
    - c. Tighten anchor bolts after supported members have been positioned and plumbed.

- d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
- e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
  - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
  - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
  - 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

### 3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction, within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
  - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed **1/4 inch in 12 feet (6 mm in 3.5 m)**.
  - 4. Secure posts, rail ends, and guard ends to building construction as follows:
    - a. Anchor posts to steel by welding to steel supporting members.
    - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
  - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements.

### 3.4 REPAIR

- A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 055113





## SECTION 055213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel railings.
  - 2. Aluminum railings.
- B. Related Requirements:
  - 1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

#### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **delegated design professional engineer**.

#### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  1. Temperature Change: **120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.**

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  1. Provide type of bracket with **predrilled hole for exposed bolt anchorage** and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

### 2.3 STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: **ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.**
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

### 2.4 ALUMINUM RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- C. Extruded Bars and Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.
- D. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- E. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
- F. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- G. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.
- H. Castings: ASTM B26/B26M, Alloy A356.0-T6.

### 2.5 FASTENERS

- A. Fastener Materials:
  - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
  - 2. Aluminum Railing Components: **Type 304** stainless steel fasteners.
  - 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or **ICC-ES AC308**.

## 2.6 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: **Cast aluminum**, center of handrail **2-1/2 inches (63.5 mm)** from **face of railing or wall**.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
  - 1. For **aluminum** railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Shop Primers: Provide primers that comply with **Section 099123 "Interior Painting."**
- D. Intermediate Coats and Topcoats: Provide products that comply with **Section 099123 "Interior Painting."**

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, **but not less than that required to support structural loads**.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
  - 1. Clearly mark units for reassembly and coordinated installation.
  - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
  - 1. Provide weep holes where water may accumulate.
  - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with **welded** connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove flux immediately.
  4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.**
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Form changes in direction as follows:
1. **By inserting prefabricated flush-elbow fittings.**
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
  2. Coordinate anchorage devices with supporting structure.
- O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

## 2.8 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Clear Anodic Finish: AAMA 611, **AA-M12C22A41.**

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
  2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
  3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

### 3.3 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with **flanges connected to** railing ends and anchored to wall construction with anchors and bolts.
- B. Attach handrails to walls with wall brackets, **except where end flanges are used**. Provide brackets with **1-1/2-inch (38-mm)** clearance from inside face of handrail and finished wall surface.
1. Use type of bracket with **predrilled hole for exposed bolt anchorage**.
  2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets **and railing end flanges** to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.

### 3.4 REPAIR

- A. Touchup Painting:



1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in **Section 099123 "Interior Painting."**

### 3.5 CLEANING

- A. Clean **aluminum** by washing thoroughly with clean water and soap and rinsing with clean water.

### 3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213



## SECTION 061000 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Wood products.
  - 2. Wood-preservative-treated lumber.
  - 3. Fire-retardant-treated lumber.
  - 4. Miscellaneous lumber.
  - 5. Plywood backing panels.
  - 6. Rooftop equipment bases and support curbs.

#### 1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, **mark grade stamp on end or back of each piece.**
  - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
  - 1. Dimension Lumber: **15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness** unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:
  - 1. UC1: Interior construction not in contact with ground or subject to moisture. Include **the following items:**
    - a. Wood sills, sleepers, blocking, **furring, stripping**, and similar concealed members in contact with masonry or concrete.
    - b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
    - c. Wood floor plates that are installed over concrete slabs-on-grade.
  - 2. UC2: Interior construction not in contact with ground but may be subject to moisture. Include **all rough carpentry.**
  - 3. UC3B (All Other Commodity Specifications): Uncoated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles including prolonged wetting. Include **all rough carpentry.**
  - 4. UC4A (All Other Commodity Specifications): Non-critical products excluding sawn products in contact with ground and exposed to all weather cycles, normal exposure conditions. Include **all rough carpentry.**

5. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. **Do not use inorganic boron (SBX) for sill plates.**
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that 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.
  1. For exposed lumber indicated to receive a stained or natural finish, **mark end or back of each piece.**
- D. Application: Treat **items indicated on Drawings, and the following:**
  1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, sleepers, blocking, **furring, stripping**, and similar concealed members in contact with masonry or concrete.

### 2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply 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 in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
  1. Treatment is not to promote corrosion of metal fasteners.
  2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
  3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
  4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
  1. For exposed lumber indicated to receive a stained or natural finish, **mark end or back of each piece.**

- E. Application: Treat **items indicated on Drawings, and the following:**
  - 1. Concealed blocking.
  - 2. Plywood backing panels.

#### 2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Cants.
  - 5. Furring.
  - 6. Grounds.
  - 7. Utility shelving.
- B. Dimension Lumber Items: **Construction or No. 2** grade lumber of **any of the following species:**
  - 1. Hem-fir (north); NLGA.
  - 2. Mixed southern pine or southern pine; SPIB.
  - 3. Spruce-pine-fir; NLGA.
  - 4. Hem-fir; WCLIB or WWPA.
  - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  - 6. Western woods; WCLIB or WWPA.
  - 7. Northern species; NLGA.
  - 8. Eastern softwoods; NeLMA.
- C. Concealed Boards: **15** percent maximum moisture content and **any of** the following species and grades:
  - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
  - 2. Hem-fir or hem-fir (north); **Construction or No. 2 Common** grade; NLGA, WCLIB, or WWPA.
  - 3. Spruce-pine-fir (south) or spruce-pine-fir; **Construction or No. 2 Common** grade; NeLMA, NLGA, WCLIB, or WWPA.
  - 4. Eastern softwoods; No. 2 Common grade; NeLMA.
  - 5. Northern species; No. 2 Common grade; NLGA.
  - 6. Western woods; **Construction or No. 2 Common** grade; WCLIB or WWPA.
- D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, **fire-retardant treated**, in thickness indicated or, if not indicated, not less than **3/4-inch (19-mm)** nominal thickness.

2.6 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches (38 mm)** into substrate.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate **furring**, nailers, blocking, **grounds**, and similar supports to comply with requirements for attaching other construction.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. ICC-ES evaluation report for fastener.



- H. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

### 3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than **1-1/2 inches (38 mm)** wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings 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. Exposed, Closet, and utility shelving.
  - 2. Premanufactured Coat Racks

#### 1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Wood-Preservative Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
  - 2. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
  - 3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Shop Drawings: For interior architectural woodwork.

1. Include plans, elevations, sections, and attachment details.
  2. Show large-scale details.
  3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
- C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.
- D. Samples for Initial Selection: For each type of exposed finish.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- 1.7 FIELD CONDITIONS
- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.
- C. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.
- D. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 INTERIOR ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom.
- B. Wood Species and Cut:
  - 1. Species: Red oak or White oak.
  - 2. Cut: Plain sliced/plain sawn.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Custom.
- B. Wood Species: Any closed-grain hardwood.

2.4 EXPOSED, CLOSET, AND UTILITY SHELVING

- A. Grade: Custom.
- B. Shelf Material: 3/4-inch (19-mm) solid lumber or veneer-faced panel product with solid-lumber edge.
- C. Cleats: 3/4-inch (19-mm) solid lumber.
- D. Wood Species:
  - 1. **Exposed Shelves**: Match species indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated
  - 2. **At Closets**: Match species indicated for door to closet where shelving is located.
- E. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.
  - 1. Heavy Duty Standards, maximum spacing of 2'-6" o.c.
- F. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.
  - 1. Heavy Duty Brackets.

- G. Closet Rods: 1-5/16-inch- (33-mm-) diameter, stainless-steel tubes complying with BHMA A156.16, L03131.
- H. Rod Flanges: Stainless steel.
- I. Wood Finish:
  - 1. Transparent Finish at Exposed and Closet shelving scheduled in office and common areas unless indicated otherwise.
  - 2. Opaque Finish at utility shelving scheduled for storage areas.

## 2.5 PREMANUFACTURED COAT RACK

- A. Wall Mounted Coat Racks:
  - a. Basis-of- Design Products: Magnuson Group 'DS Series'
    - 1) [www.magnusongroup.com](http://www.magnusongroup.com)
  - b. Powder-coated steel coat rack with stainless steel hanger bar.
    - 1) Model 'DS-6H'
      - a) Width: See drawings.
      - b) Height: 6-1/2 inches.
      - c) Depth: 11-1/2 inches.
      - d) Color: Black
  - c. All powder-coated steel coat rack.
    - 1) Model 'DS-2H'
      - a) Width: See Drawings.
      - b) Height: 6-1/2 inches.
      - c) Depth: 11-1/2 inches
      - d) Color: Black.
- 2. Installation:
  - a. Install Model DS-4H at standard mounting height.
  - b. Install Model DS-2U in compliance with accessibility reach limits, max. 48".
    - 1) Install as indicated on drawings.

## 2.6 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
  - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
  - 2. Wood Moisture Content: 8 to 13 percent.

## 2.7 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, or Fire-retardant-treated softwood lumber where indicated for fire-rated construction, kiln-dried to less than 15 percent moisture content.
  - 1. Fire-Retardant Treatment: Complying with requirements; provide where indicated or required for scheduled fire-rated construction.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

## 2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
  - 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
  - 1. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
  - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that parts fit as intended and check measurements of assemblies

against field measurements indicated on approved Shop Drawings before disassembling for shipment.

## 2.9 SHOP PRIMING

- A. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099123 "Interior Painting."
- B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork.

## 2.10 SHOP FINISHING

- A. General: Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: System - 12, water-based polyurethane.
  - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
  - 4. Staining: Match approved sample for color.
  - 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
  - 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.



**3.2 INSTALLATION**

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
  - 1. For shop-finished items, use filler matching finish of items being installed.
- H. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 30 inches o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing.
- I. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.
  - 1. Install shelves, fully seated on brackets, and supports.
  - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
- J. Touch up finishing work specified in this Section after installation of interior architectural woodwork. Fill nail holes with matching filler where exposed.

**3.3 ADJUSTING AND CLEANING**

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects. Where not possible to repair, replace interior architectural woodwork. Adjust joinery for uniform appearance.
- B. Clean interior architectural woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023



## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Extruded polystyrene foam-plastic board insulation.

- B. Related Requirements:

- 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
- 2. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Extruded polystyrene foam-plastic board insulation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Research Reports: For foam-plastic insulation, from ICC-ES.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

## PART 2 - PRODUCTS

### 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning; Foamular 250 or a comparable product by one of the following:
    - a. DuPont de Nemours, Inc.
    - b. The Dow Chemical Company.
  - 2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
  - 3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
  - 4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
  - 5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

#### 3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

#### 3.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.
  - 1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
  - 2. Press units firmly against inside substrates.
  - 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

#### 3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100



## SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vapor-permeable, fluid-applied air barriers.

#### 1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.



- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build integrated mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils (0.4 to 0.8 mm) over smooth, void-free substrates.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. DuPont de Nemours, Inc.
    - c. Sto Corp.
    - d. W.R. Meadows, Inc.
    - e. Other manufacturers with approval by Architect prior to bidding.
  - 2. Physical and Performance Properties:
    - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
    - b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
    - c. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
    - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541.
    - e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
    - f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

**2.4 ACCESSORY MATERIALS**

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide The Dow Chemical Company ; Dow Corning® 123 Silicone Seal. or a comparable product by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Pecora Corporation.
    - c. Tremco Incorporated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved

over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
  2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

### 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

**3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Air-barrier dry film thickness.
  - 3. Continuous structural support of air-barrier system has been provided.
  - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 5. Site conditions for application temperature and dryness of substrates have been maintained.
  - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 7. Surfaces have been primed, if applicable.
  - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 9. Termination mastic has been applied on cut edges.
  - 10. Strips and transition strips have been firmly adhered to substrate.
  - 11. Compatible materials have been used.
  - 12. Transitions at changes in direction and structural support at gaps have been provided.
  - 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  - 14. All penetrations have been sealed.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- E. Prepare test and inspection reports.

**3.6 CLEANING AND PROTECTION**

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726



## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes: Standing-seam metal roof panels.
- B. Related Requirements:
  - 1. Section 077353 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review structural loading limitations of **deck, purlins and rafters** during and after roofing.
  - 6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
  - 7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 8. Review temporary protection requirements for metal panel systems during and after installation.
  - 9. Review procedures for repair of metal panels damaged after installation.
  - 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
  - 1. Include similar Samples of trim and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof area and eave, **including fascia**, as shown on Drawings; approximately **48 inches (1200 mm)** square by full thickness, including attachments, **underlayment**, and accessories.
  - 2. Build mockups for typical roof area only, including accessories.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

#### 1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.11 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: **Two** years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: **20** years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Warranty Period: **20** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: **As indicated on Drawings.**
  3. Deflection Limits: For wind loads, no greater than **1/240** of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 at the following test-pressure difference:
1. Test-Pressure Difference: **1.57 lbf/sq. ft. (75 Pa).**
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
1. Test-Pressure Difference: **2.86 lbf/sq. ft. (137 Pa).**
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: **UL 60.**
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): **120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.**

## 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
  2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
- B. Integral-Standing-Seam Metal Roof Panels: Formed with integral ribs at panel edges and **intermediate stiffening ribs symmetrically spaced** between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and lapping and interconnecting side edges of adjacent panels.
1. Basis-of-Design Product: Subject to compliance with requirements, provide ATAS International, Inc. ; Dutch Seam. or a comparable product by one of the following:
    - a. Everlast Metals.
    - b. McElroy Metal, Inc.
    - c. Morin - A Kingspan Group Company.
  2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
    - a. Thickness: **0.040 inch (1.02 mm)**.
    - b. Surface: **Smooth, flat** finish.
    - c. Exterior Finish: **Two-coat fluoropolymer**.
    - d. Color: **As selected by Architect from manufacturer's full range**.
  3. Clips: **One-piece fixed** to accommodate thermal movement.
    - a. **0.064-inch- (1.63-mm-)** nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
  4. Panel Coverage: **15 inches (381 mm)**.
  5. Panel Height: **1.5 inches (38 mm)**.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D1970.

3. 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. ATAS International, Inc.
  - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
  - c. GCP Applied Technologies Inc.
  - d. Henry Company.
  - e. Owens Corning.
  - f. Polyglass U.S.A., Inc.
- B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match **metal roof panels**.
- D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.



2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated **on Drawings**, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
- B. Felt Underlayment: Apply at locations indicated **on Drawings**, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

### 3.3 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
- B. Fasteners:
  - 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 4. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
- F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
  - 1. Connect downspouts to underground drainage system indicated.

### 3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16



## SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes metal composite material wall panels.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
  - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
  - 8. Review procedures for repair of panels damaged after installation.
  - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 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 type of panel and accessory.
- B. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Metal Composite Material Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
  - B. Product Test Reports: For each product, tests performed by a qualified testing agency.
  - C. Field quality-control reports.
  - D. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
    1. Build mockup of typical metal composite material panel assembly, including corner, supports, attachments, and accessories.
    2. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
    3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
    4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.



**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

**1.9 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.10 COORDINATION**

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including rupturing, cracking, or puncturing.
- b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
  1. Wind Loads: As indicated on Drawings.
  2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:
  1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

### 2.2 METAL COMPOSITE MATERIAL WALL PANELS

- A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from metal facings that are bonded to a solid, extruded thermoplastic core or similar corrugated core; formed into profile for a concealed fastener installation method indicated. Include attachment assembly components and accessories required for weathertight system.
  1. Basis-of-Design Product – Panel A: Subject to compliance with requirements, provide ATAS International, Inc.; Sterracore Metal Composite panels or a comparable product by one of the following:
    - a. Alcotex Inc.
    - b. ALUCOBOND; 3A Composites USA, Inc.
    - c. Arconic.
    - d. Fairview Architectural.

- e. Other manufacturer's products with approval by Architect prior to bidding.
- 2. Basis-of-Design Product - Panel B: Subject to compliance with requirements, provide ATAS International, Inc.; Belvedere 7.2" Rib or a comparable product by one of the following:
  - a. Alcotex Inc.
  - b. ALUCOBOND; 3A Composites USA, Inc.
  - c. Arconic.
  - d. Fairview Architectural
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.030-inch- thick, coil-coated aluminum sheet facings.
  - 1. Panel Thickness: 6 mm.
  - 2. Core: Standard.
  - 3. Exterior Finish: Two-coat fluoropolymer.
    - a. Color: As selected by Architect from manufacturer's full range.
- C. Attachment Assembly Components: Formed from material compatible with panel facing.
- D. Attachment Assembly: Manufacturer's standard concealed fastener Dry Seal system, or similar meeting project requirements.

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

**2.4 FABRICATION**

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

**2.5 FINISHES**

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
  1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
  2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal composite material panel manufacturer's written recommendations.

#### **3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION**

- A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  1. Shim or otherwise plumb substrates receiving metal composite material panels.
  2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
  3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal composite material panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
1. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
  2. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-turned flanges of wall panels to panel clips with manufacturer's standard fasteners.
1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
  2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- G. Subgirt-and-Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
  2. Do not apply sealants to joints unless otherwise indicated.

- H. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal and vertical tracks and drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
  - 1. Attach routed-and-turned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
  - 2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
  - 3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
  - 4. Do not apply sealants to joints unless otherwise indicated.
  
- I. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
  - 1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
  - 2. Do not apply sealants to joints unless otherwise indicated.
  
- J. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.
  
- K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
  - 1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

### 3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location



lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.5 FIELD QUALITY CONTROL

- A. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- C. Metal composite material wall panels will be considered defective if they do not pass test and inspections.
- D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

## SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Roof insulation.
3. Cover board.
4. Walkways.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry for wood nailers, curbs, and blocking.
2. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 077200 "Roof Accessories" for manufactured copings.
5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

#### 1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
  1. Layout and thickness of insulation.
  2. Base flashings and membrane terminations.
  3. Flashing details at penetrations.
  4. Tapered insulation, thickness, and slopes.
  5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
  6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates:
  1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
    - a. Submit evidence of complying with performance requirements.
  2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
  1. Field Test Reports:
  2. Concrete internal relative humidity test reports.

3. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

#### 1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

#### 1.8 QUALITY ASSURANCE

A. Qualifications:

1. Installers: 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 special warranty.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

#### 1.10 FIELD 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 instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
  - 2. Warranty Period: 20 years from Date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, for the following warranty period:
  - 1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings to remain watertight.
  - 1. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
  - 2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
  - 1. Comply with current Building Code Requirements for the building type, location, exposure, and any requirements of the local authorities having jurisdiction. Installation shall meet uplift requirements for the following:
    - a. Zone 1 (Roof Area Field)
    - b. Zone 2 (Roof Area Perimeter):
    - c. Zone 3 (Roof Area Corners):

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet: ASTM D4637/D4637M, Type II, scrim or fabric internally reinforced, EPDM sheet with factory-applied seam tape.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlisle SynTec Incorporated.
  - b. Firestone Building Products.
  - c. Johns Manville; a Berkshire Hathaway company.
  - d. Mule-Hide Products Co., Inc.
  - e. Versico Roofing Systems.
2. Thickness: 90 mils, nominal.
3. Exposed Face Color: White.
4. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

### 2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.
- C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils (1.4 to 1.5 mm) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- F. Bonding Adhesive: Manufacturer's standard, water based.
- G. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- H. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- I. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

#### 2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2 coated glass-fiber facer on both major surfaces.
  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. Atlas Polyiso Roof and Wall Insulation.
    - b. Carlisle Syntec Systems.
    - c. Certainteed; SAINT-GOBAIN.
    - d. Firestone Building Products.
    - e. GAF.
    - f. Johns Manville; a Berkshire Hathaway company.
  2. Compressive Strength: 25 psi (172 kPa).
  3. Size: 48 by 96 inches (1219 by 2438 mm).
  4. Thickness:
    - a. Base Layer: 3 inches (76 mm).
    - b. Upper Layer: 3 inches (76 mm).
- C. Tapered Insulation: Provide factory-tapered insulation boards.
  1. Material: Match roof insulation.
  2. Minimum Thickness: 1/4 inch (6.35 mm).
  3. Slope:
    - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

#### 2.5 INSULATION ACCESSORIES AND COVER BOARD

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover board to substrate, and acceptable to roofing system manufacturer.



- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
  - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
  - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
  - 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
  
- D. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum substrate.
  - 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. Certainteed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  - 2. Thickness: 1/2 inch (13 mm).
  - 3. Surface Finish: Factory Primed.

## 2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
  - 1. Size: Approximately 30 by 30 inches (762 by 762 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
  
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
  - 1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

### 3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
  - 1. Install base layer of insulation with [joints staggered not less than 24 inches (610 mm) in adjacent rows.
    - a. Locate end joints over crests of decking.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

- 1) Trim insulation so that water flow is unrestricted.
  - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
  - a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
  - b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
  - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
  - f. Trim insulation so that water flow is unrestricted.
  - g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
  - i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
    - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
  1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

2. At internal roof drains, conform to slope of drain sump. Trim cover board so that water flow is unrestricted.
3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Loosely lay cover board over substrate.
5. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
  - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.
  1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
  2. Apply lap sealant and seal exposed edges of roofing terminations.
  3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.
- I. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.
  1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
  2. Apply lap sealant and seal exposed edges of roofing terminations.
- J. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

- K. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

### 3.7 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.8 INSTALLATION OF WALKWAYS

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
  - 1. Install flexible walkways at the following locations:
    - a. Locations indicated on Drawings.
  - 2. Provide 6-inch (76-mm) clearance between adjoining pads.
  - 3. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
  - 1. Owner: Reading Muhlenberg Career and Technology Center.
  - 2. Owner Address: 2615 Warren Road, Reading, PA, 19604.
  - 3. Building Name/Type: Reading Muhlenberg Career and technology Center
  - 4. Building Address: 2615 Warren Road, Reading, PA 19604
  - 5. Area of Work: 8,500 SF.
  - 6. Acceptance Date: \_\_\_\_\_.
  - 7. Warranty Period: 20 Years.
  - 8. Expiration Date: \_\_\_\_\_.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. lightning;
    - b. peak gust wind speed exceeding the design wind speed of established by the 2015 IBC for the buildings location.
    - c. fire;
    - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;

- f. vapor condensation on bottom of roofing; and
  - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
  6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
  7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

1. Authorized Signature: \_\_\_\_\_.
2. Name: \_\_\_\_\_.
3. Title: \_\_\_\_\_.

END OF SECTION 075323





## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Wall sheet metal fabrications.
4. Miscellaneous sheet metal fabrications.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 042000 "Unit Masonry" for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
3. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.
4. Section 074213.23 "Metal Composite Material Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
5. Section 077200 "Roof Accessories" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.
6. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

#### 1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

#### 1.4 PREINSTALLATION MEETINGS

- A. 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.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following
  1. Underlayment materials.
  2. Elastomeric sealant.
- B. Shop Drawings: For sheet metal flashing and trim.
  1. Include plans, elevations, sections, and attachment details.
  2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  4. Include details for forming, including profiles, shapes, seams, and dimensions.
  5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  6. Include details of termination points and assemblies.
  7. Include details of roof-penetration flashing.
  8. Include details of special conditions.
  9. Include details of connections to adjoining work.
  10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.
- D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- E. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.
- F. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- G. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.
- H. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- 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 box gutter, fascia, and fascia trim, approximately 10 feet (3.0 m) 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 Owner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.8 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.
  - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
  - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

**1.9 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 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" 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 tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: Meet local building code requirements.
- 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

**2.2 SHEET METALS**

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless Steel Sheet: ASTM Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
  - 1. Finish: ASTM A480/A480M, No. 2B (bright, cold rolled).
    - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
- C. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.
  - 1. Surface: Smooth, flat.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare,

pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- D. Lead Sheet: ASTM B749 lead sheet.

### 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
1. Source Limitations: Obtain underlayment from single source from single manufacturer.
  2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

### 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- F. 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. Source Limitations: Obtain reglets from single source from single manufacturer.
  - 2. Material: Aluminum, 0.024 inch (0.61 mm) 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. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  - 5. 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.
  - 6. Finish: Mill.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricated sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 2. 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.
  - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  - 4. 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.
  - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.



- B. Fabrication Tolerances:
  - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
  - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
  - 1. 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.
- H. Do not use graphite pencils to mark metal surfaces.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters:
  - 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
  - 2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
  - 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
  - 4. Gutter Profile: Box Gutter.
    - a. Size: As indicated on drawings.

- B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

## 2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.0156 inch (0.396 mm) thick.

## 2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.0188 inch (0.477 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
  - 1. Install in shingle fashion to shed water.
  - 2. Lap joints not less than 2 inches (50 mm).
- B. Self-Adhering, High-Temperature Sheet Underlayment:
  - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
  - 2. Prime substrate if recommended by underlayment manufacturer.

3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
  6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  8. Do not field cut sheet metal flashing and trim by torch.
  9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum 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.
1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

- 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.
    - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
  - 1. Join sections with riveted and soldered joints or joints sealed with sealant.
  - 2. Provide for thermal expansion.
  - 3. Attach gutters at eave or fascia to firmly anchor them in position.
  - 4. Provide end closures and seal watertight with sealant.
  - 5. Slope to downspouts.
  - 6. Fasten gutter spacers to front and back of gutter.
  - 7. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
  - 8. Anchor gutter with gutter brackets spaced not more than 36 inches (910 mm) apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
  - 9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.
- C. Downspouts:
  - 1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
  - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
  - 3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
  - 4. Connect downspouts to underground drainage system.

**3.5 INSTALLATION OF ROOF FLASHINGS**

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
  - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Copings:
  - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  - 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
    - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
  - 3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  - 2. Extend counterflashing 4 inches (100 mm) over base flashing.
  - 3. Lap counterflashing joints minimum of 4 inches (100 mm).
  - 4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

**3.6 INSTALLATION OF WALL FLASHINGS**

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with 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. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

**3.7 INSTALLATION OF MISCELLANEOUS FLASHING**

- A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.9 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

### 3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. 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, as determined by Architect.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Preformed flashing sleeves.
5. Copings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Section 075323 "EPDM Roofing"
4. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
5. Section 077353 "Snow Guards" for snow guards.
6. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.



1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
  - C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof mounted items. Show the following:
    1. Size and location of roof accessories specified in this section.
    2. Method of attaching roof accessories to roof or building structure.
    3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
    4. Required clearances.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Sample Warranties: For manufacturer's special warranties.
- 1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.
- 1.6 WARRANTY
- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
    1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
      - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
    2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
  1. Design Pressure: Meeting local building code requirements.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
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. [Air Balance; MESTEK, Inc.](#)
    - b. [Curbs Plus, Inc.](#)
    - c. [Thybar Corporation.](#)
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Steel: Zinc-coated (galvanized) steel sheet.
1. Finish: Factory prime coating.
- E. Construction:
1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. Fabricate curbs to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.
  3. Insulation: Factory insulated with **1-1/2-inch- (38-mm-)** thick glass-fiber board insulation.
  4. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  5. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
  6. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from **3/4-inch- (19-mm-)** thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

## 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.
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. Air Balance; MESTEK, Inc.
    - b. Greenheck Fan Corporation.
    - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - d. Lloyd Industries, Inc.
    - e. Louvers & Dampers, Inc.; Mestek, Inc.
    - f. Pate Company (The).
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Steel: Zinc-coated (galvanized).
1. Finish: Factory prime coating.
- E. Construction:
1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. Insulation: Factory insulated with **1-1/2-inch- (38-mm-)** thick glass-fiber board insulation.
  3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
  4. Nailer: Factory-installed continuous wood nailers under top flange on side of curb, continuous around support perimeter.
  5. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from **3/4-inch- (19-mm-)** thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  6. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
  7. Fabricate equipment supports to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.

## 2.4 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

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. BILCO Company (The).
  - b. Babcock-Davis.
  - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
  - d. Metallic Products Corporation.
- B. Type and Size:
  1. Single-leaf lid, **36 by 36 inches (900 by 900 mm)**.
- C. Loads: Minimum **40-lbf/sq. ft. (1.9-kPa)** external live load and **20-lbf/sq. ft. (0.95-kPa)** internal uplift load.
- D. Hatch Material, Steel: Zinc-coated (galvanized) steel sheet.
  1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  2. Finish: Baked enamel or powder coat.
  3. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
  1. Insulation: **2-inch- (50-mm-)** thick, polyisocyanurate board.
  2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
  6. Fabricate curbs to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.
- F. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
  1. Height: **42 inches (1060 mm)** above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, **1-1/4 inches (31 mm)** in diameter or galvanized-steel tube, **1-5/8 inches (41 mm)** in diameter.
  3. Maximum Opening Size: System constructed to prevent passage of a sphere **21 inches (533 mm)** in diameter.
  4. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  5. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  6. Fabricate joints exposed to weather to be watertight.
  7. Fasteners: Manufacturer's standard, finished to match railing system.

8. Finish: Manufacturer's standard.

## 2.5 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and slotted metal collar.
  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. Custom Solution Roof and Metal Products.
    - b. Menzies Metal Products.
    - c. Thaler Metal USA Inc.
  2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
  3. Diameter: As indicated or required for vent.
  4. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
  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. [Custom Solution Roof and Metal Products, a division of Colony Heating.](#)
    - b. [Menzies Metal Products.](#)
    - c. [Milcor; Hart & Cooley, Inc.](#)
    - d. [Thaler Metal Industries Ltd.](#)
  2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
  3. Height: 13 inches (330 mm).
  4. Diameter: As indicated or required for vent.
  5. Finish: Manufacturer's standard.

## 2.6 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
  4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than **1-1/2 inches (38 mm)** thick.
- E. Underlayment:
1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  2. Polyethylene Sheet: **6-mil- (0.15-mm-)** thick polyethylene sheet complying with ASTM D4397.
  3. Slip Sheet: Building paper, **3 lb/100 sq. ft. (0.16 kg/sq. m)** minimum, rosin sized.
  4. Self-Adhering, High-Temperature Sheet: Minimum **30 to 40 mils (0.76 to 1.0 mm)** thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- F. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

## 2.7 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding **12 feet (3.6 m)**, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
1. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide [OMG Roofing Products; a Division of OMG, Inc., a subsidiary of Steel Partners Holdings L.P.;](#) Permasnap Plus; or a comparable product by one of the following:
    - a. [ATAS International, Inc.](#)
    - b. [Castle Metal Products.](#)
    - c. [Metal-Era, Inc.](#)
    - d. [PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.](#)
    - e. [SAF Perimeter Systems Division.](#)
  2. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Three-coat fluoropolymer.

- c. Color: As selected by Architect from manufacturer's full range.
- 3. Corners: Factory mitered and mechanically clinched and sealed watertight.
- 4. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
  - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
  - b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet,

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- D. Coil-Coated Aluminum Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).



**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION OF UNDERLAYMENT**

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under copings, roof-edge specialties and reglets and counterflashings.
  - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

**3.3 INSTALLATION, GENERAL**

- A. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  2. Attach safety railing system to roof-hatch curb.
  3. Attach ladder-assist post according to manufacturer's written instructions.
- F. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- G. Preformed Flashing-Sleeve and Flashing-Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
- H. Seal joints with butyl sealant as required by roof accessory manufacturer.
- I. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).
- 3.4 INSTALLATION OF COPINGS
- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at maximum 30-inch (762-mm) centers unless manufacturer's required spacing is less so that installation meets performance requirements.
- 3.5 CLEANING
- A. Clean exposed surfaces according to manufacturer's written instructions.

- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200



## SECTION 077353 - SNOW GUARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings 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. Rail-type, seam-mounted snow guards.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
  - 1. Include details of rail-type snow guards.

#### 1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

### PART 2 - PRODUCTS

#### 2.1 RAIL-TYPE SNOW GUARDS

- A. Rail-Type, Seam-Mounted Snow Guards:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide S-5! Metal Roof Innovations, Ltd.; ColorGard or a comparable product by one of the following:
    - a. Alpine SnowGuards.
    - b. Berger; division of OmniMax International, Inc.
    - c. IceBlox Inc.
    - d. PMC Industries, Inc.
    - e. TRA Snow and Sun, Inc.
  - 2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with one rail.
  - 3. Brackets and Baseplate: **ASTM B209** (**ASTM B209M**) aluminum; mill finished

4. Bars: **ASTM B221** (**ASTM B221M**) aluminum; mill finish.
  - a. Profile: Round.
5. Seam clamps: **ASTM B221** (**ASTM B221M**) aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
  1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

#### 3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions.
- B. Attachment for Standing-Seam Metal Roofing:
  1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
    - a. Mechanically attach to metal roofing according to manufacturer's instructions.
  2. Rail-Type, Seam-Mounted Snow Guards:
    - a. Install brackets to vertical ribs in straight rows.
    - b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
    - c. Torque set screw according to manufacturer's instructions.
    - d. Install cross members to brackets.

END OF SECTION 077253

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Nonstaining silicone joint sealants.
  - 3. Mildew-resistant joint sealants.
  - 4. Latex joint sealants.
  - 5. Butyl joint sealants.
- B. Related Requirements:
  - 1. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 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.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by.
- B. Field-Adhesion-Test Reports: For each sealant application tested.
- C. Sample Warranties: For special warranties.



1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 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 or are below 40 deg F (5 deg C).
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - d. Pecora Corporation.
    - e. Sika Corporation.

**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, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Dow Corning Corporation.
    - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - c. Pecora Corporation.
    - d. Tremco Incorporated.

**2.4 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - d. Pecora Corporation.
    - e. Tremco Incorporated.

**2.5 LATEX JOINT SEALANTS**

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Construction Chemicals – Building Systems.
    - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - c. Pecora Corporation.
    - d. Sherwin-Williams Company (The).
    - e. Tremco Incorporated.

**2.6 BUTYL JOINT SEALANTS**

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bostik, Inc.
  - b. Pecora Corporation.

## 2.7 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. Alcot Plastics Ltd.
    - b. BASF Corporation; Construction Systems.
    - c. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.8 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.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
- 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.
  - 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.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 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 five (5) tests for the first 500 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one (1) test for each 1000 of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 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.

### 3.6 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.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between different materials.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: See Section 321373 "Concrete Paving Joint Sealants."

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces; JS#1.
1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors windows and louvers.
    - f. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces; JS#2.
1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, S, NS, 100/50, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces; JS#3.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement; JS#4.
1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - c. Miscellaneous joints and intersections of materials not identified in other application designations.
    - d. Other joints at intersections of painted surfaces.



- e. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces; JS#5.
- 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Perimeter joints at lavatory counters.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics; JS#6.
- 1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Butyl-rubber based.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. Exterior standard steel doors and frames.
- B. Related Requirements:
  - 1. **Section 087100 "Door Hardware"** for door hardware for hollow-metal doors.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.

2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of **thermally rated door assemblies** for tests performed by a qualified testing agency indicating compliance with performance requirements.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch- (102-mm-)** high wood blocking. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. [BARON Metal Industries, Inc.; ASSA ABLOY of Canada, Ltd.; ASSA ABLOY.](#)
2. [Ceco Door; AADG, Inc.; ASSA ABLOY.](#)
3. [Concept Frames, AADG, Inc.; ASSA ABLOY Group.](#)
4. [Curries, AADG, Inc.; ASSA ABLOY Group.](#)
5. [Fleming Door Products Ltd.; ASSA ABLOY Group.](#)
6. [HMF Express.](#)
7. [Karpen Steel Custom Doors & Frames.](#)
8. [MegaMet Industries.](#)
9. [Metropolitan Door Industries Corp.](#)
10. [Philipp Manufacturing Co \(The\).](#)
11. [Steelcraft; Allegion plc.](#)

2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than U-0.37 when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches (44.5 mm).
- c. Face: **Uncoated** steel sheet, minimum thickness of 0.042 inch (1.0 mm).
- d. Edge Construction: **Model 1, Full Flush**.
- e. Edge Bevel: **Provide manufacturer's standard beveled or square edges**.
- f. Core: **Manufacturer's standard**.

2. Frames:

- a. Materials: **Uncoated** steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- b. Construction: **Knocked down**.

3. Exposed Finish: **Prime**.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches (44.5 mm).
- c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum **A40 (ZF120)** coating.
- d. Edge Construction: **Model 1, Full Flush**.
- e. Edge Bevel: **Provide manufacturer's standard beveled or square edges**.
- f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- g. Bottom Edges: Close bottom edges of doors **where required for attachment of weather stripping** with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: **Manufacturer's standard**.

2. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
  - b. Construction: **Full profile welded.**
3. Exposed Finish: **Prime.**

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
  3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## 2.7 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with **ANSI/SDI A250.11** and **NAAMM-HMMA 840**.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

- a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
- b. Install frames with removable stops located on secure side of opening.
2. Floor Anchors: Secure with postinstalled expansion anchors.
  - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  1. Non-Fire-Rated Steel Doors: Comply with **ANSI/SDI A250.8, NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.**

### 3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

## SECTION 083323 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Insulated service doors.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Show locations of controls, locking devices, and other accessories.
  - 6. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.



1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: Uniform pressure (velocity pressure) of **20 lbf/sq. ft. (960 Pa)**, acting inward and outward.
  - 2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.
  - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of **20-lbf/sq. ft. (960-Pa)** wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; 627 Stormtite Insulated, or a comparable product by one of the following:
    - a. Clopay Building Products.

- b. [Cookson; a CornellCookson company.](#)
  - c. [Cornell; a CornellCookson company.](#)
  - d. [Raynor Garage Doors.](#)
  - e. [Wayne Dalton; a division of Overhead Door Corporation.](#)
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283 or DASMA 105.
- D. STC Rating: 21.
- E. Insulated Door Curtain R-Value: R-7.7.
- F. Door Curtain Material: Aluminum.
- G. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm)] [3-1/4-inch (83-mm) center-to-center height.
- 1. Vision Panels: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in two rows of slats at height indicated on Drawings; installed with[ insulated] vision-panel glazing.
  - 2. Insulated-Slat Interior Facing: Metal.
  - 3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from aluminum extrusions and finished to match door.
- I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- J. Hood: Match curtain material and finish.
- 1. Shape: Square.
  - 2. Mounting: Face of wall.
- K. Locking Devices: Equip door with locking device assembly.
- 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn.
- L. Manual Door Operator: Chain-hoist operator.
- M. Door Finish:
- 1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.

## 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Aluminum Door Curtain Slats: ASTM B209 (ASTM B209M) sheet or ASTM B221 (ASTM B221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch (1.27 mm); and as required.
  2. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
  3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B209 (ASTM B209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

## 2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

## 2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

## 2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. \
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.11 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

**3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

**3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

**3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Aluminum-framed storefront systems.
  - 2. Aluminum-framed entrance door systems.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Certificates:
  - 1. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
    - a. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- B. Sample warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.

#### 1.7 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.8 WARRANTY

- A. Special Warranty: **Manufacturer** agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.

- c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: **10** years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, peeling, or chipping.
  - 2. Warranty Period: **10** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- B. Structural Loads:
  - 1. Wind Loads:
    - a. Allowable Stress Design Load: 20 PSF (960)
    - b. LRFD Ultimate Design Load: 33 PSF (1580)



- C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to **1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).**
  2. Deflection Parallel to Glazing Plane: Limited to **amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).**
  3. Cantilever Deflection: Limited to  $2L/175$  at unsupported cantilevers.
- D. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  2. When tested at **150 percent** of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding **0.2 percent** of span.
  3. Test Durations: As required by design wind velocity, but not less than **10 seconds**.
- E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa).**
- F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa).**
  2. Maximum Water Leakage: **In accordance with AAMA 501.1.** Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- G. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined in accordance with **ASCE/SEI 7.**
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement.
- H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than **0.38 Btu/sq. ft. x h x deg** as determined in accordance with NFRC 100.
    - b. Entrance Doors: U-factor of not more than **0.77 Btu/sq. ft. x h x deg F (4.37 W/sq. m x K)** as determined in accordance with NFRC 100.

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2. Solar Heat-Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.38 SEW and 0.51 N as determined in accordance with NFRC.
    - b. Entrance Doors: SHGC of not more than **0.40** as determined in accordance with NFRC 200.
  3. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than **0.06 cfm/sq. ft. (0.30 L/s per sq. m)** at a static-air-pressure differential of **1.57 lbf/sq. ft. (75 Pa)** when tested in accordance with ASTM E283.
    - b. Entrance Doors: Air leakage of not more than **1.0 cfm/sq. ft. (5.08 L/s per sq. m)** at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
  - I. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone **2** for **basic** protection.
    1. Large-Missile Test: For glazing located within **30 feet (9.1 m)** of grade.
    2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and **60 feet (18.3 m)** above grade.
  - J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
    1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
    2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
      - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of **180 deg F (82 deg C)**.
      - b. Low Exterior Ambient-Air Temperature: **0 deg F (minus 18 deg C)**.
      - c. Interior Ambient-Air Temperature: **75 deg F (24 deg C)**.
- 2.3 STOREFRONT SYSTEMS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc.; Arconic Corporation; Trifab VersaGlaze 451T Framing System, or a comparable product by one of the following:
    1. EFCO Corporation.
    2. Oldcastle BuildingEnvelope (OBE); CRH Americas, Inc.
    3. Tubelite Inc.
    4. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
    5. YKK AP America Inc.
  - B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: **Thermally broken.**
  2. Glazing System: **Retained mechanically with gaskets on four sides.**
  3. Glazing Plane: **Center.**
  4. Finish: **Clear anodic finish.**
  5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc.; Arconic Corporation; #350 Medium Stile Door; or a comparable product by one of the following:
1. EFCO Corporation.
  2. Oldcastle BuildingEnvelope (OBE); CRH Americas, Inc.
  3. Tubelite Inc.
  4. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
  5. YKK AP America Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: **1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm-) thick**, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: **High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.**
  2. Door Design: **Medium stile; 3-1/2-inch (88.9-mm) nominal width.**
  3. Glazing Stops and Gaskets: **Beveled**, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.
  4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in **Section 087100 "Door Hardware."**
- B. General: Provide entrance door hardware and **entrance door hardware sets indicated in door and frame schedule** for each entrance door, to comply with requirements in this Section.
  - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and **products complying with BHMA standard referenced.**
  - 2. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion **and not more than 15 lbf (67 N) to open the door to its minimum required width.**
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
  - 1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
  - 2. Exterior Hinges: **Stainless steel, with stainless steel pin.**
  - 3. Quantities:
    - a. For doors up to **87 inches (2210 mm)** high, provide three hinges per leaf.
    - b. For doors more than **87 and up to 120 inches (2210 and up to 3048 mm)** high, provide four hinges per leaf.
- E. Continuous-Gear Hinges: BHMA A156.26.
- F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- G. Cylinders:
  - 1. **As specified in Section 087100 "Door Hardware."**
  - 2. BHMA A156.5, Grade 1.

- a. Keying: **Master** key system. Permanently inscribe each key with a visual key control number and include notation "**DO NOT DUPLICATE**".
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: BHMA A156.6.
- J. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- K. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.
- L. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
- M. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- N. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

## 2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: **Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.**
- C. Glazing Sealants: **Comply with Section 088000 "Glazing."**
- D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
  - 1. Color: Match structural sealant.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch (25.4 mm)** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: **Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.**

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from **exterior**.
  6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using **screw-spline system**.

- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **AA-M12C22A41, Class I, 0.018 mm** or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

### 3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

### 3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

### 3.5 INSTALLATION OF WEATHERSEAL SEALANT

A. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

### 3.6 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.7 ERECTION TOLERANCES

A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:



- a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
  - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

### 3.8 MAINTENANCE SERVICE

#### A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide **six** months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084113

## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware.
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
- D. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series.
  - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
  - 3. UL 305 - Panic Hardware.

#### 1.2 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  - 3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.

- f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
  - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
  - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

### 1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Requirements for key control storage and software.
  4. Installation of permanent keys, cylinder cores and software.
  5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
  - B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
  - C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".
- 1.5 COORDINATION
- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
  - B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

**1.6 WARRANTY**

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
  - 2. Five years for exit hardware.
  - 3. Twenty five years for manual overhead door closer bodies.
  - 4. Two years for electromechanical door hardware, unless noted otherwise.

**1.7 MAINTENANCE SERVICE**

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

**PART 2 - PRODUCTS**

**2.1 SCHEDULED DOOR HARDWARE**

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
  - 1. Permanent cylinders, cores, and keys to be installed by Owner.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

**2.2 HANGING DEVICES**

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'6": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'7" to 4'0": 5" standard or heavy weight as specified.
  3. Manufacturers:
    - a. McKinney (MK).
- B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 certified pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Manufacturers:
    - a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
- 2.3 POWER TRANSFER DEVICES
- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
1. Manufacturers:
    - a. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
- 2.4 DOOR OPERATING TRIM
- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Manufacturers:
    - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:
  - a. Rockwood (RO).

## 2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
  1. Threaded mortise cylinders with rings and cams to suit hardware application.
  2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
  4. Tubular deadlocks and other auxiliary locks.
  5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  6. Keyway: Match Facility Restricted Keyway.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
  1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
  2. Manufacturers:
    - a. Yale Commercial (YA) - Keymark.
    - b. No Substitution.
- F. Keying System: Each type of lock and cylinders to be factory keyed.
  1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. Existing System: Field verify and key cylinders to match Owner's existing system.
- G. Key Quantity: Provide the following minimum number of keys:
  1. Change Keys per Cylinder: Two (2)
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
  4. Construction Control Keys (where required): Two (2).
- H. Construction Keying: Provide temporary keyed construction cores.
- I. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

**2.6 MECHANICAL LOCKS AND LATCHING DEVICES**

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
1. Vertical Impact: Exceed 100 vertical impacts (20 times ANSI/BHMA A156.2 requirements).
  2. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
  3. Locks are to be non-handed and fully field reversible.
  4. Manufacturers:
    - a. Yale Commercial (YA) 5400LN Series.
    - b. No Substitution.

**2.7 AUXILIARY LOCKS**

- A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation and 1 3/8" to 1 3/4" thickness doors. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.
1. Manufacturers:
    - a. Yale Commercial (YA) - D100 Series.
    - b. No Substitution.

**2.8 LOCK AND LATCH STRIKES**

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
1. Strikes for Bored Locks and Latches: BHMA A156.2.
  2. Strikes for Auxiliary Deadlocks: BHMA A156.36.
  3. Dustproof Strikes: BHMA A156.16.

**2.9 CONVENTIONAL EXIT DEVICES**

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.



2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  8. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  9. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
    - a. Yale (YA) - 7000 Series.
    - b. No Substitution.

## 2.10 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of

use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:
  - a. Yale Commercial (YA) - 4400 Series.
  - b. No Substitution.

## 2.11 ARCHITECTURAL TRIM

### A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
  - a. Rockwood (RO).

## 2.12 DOOR STOPS AND HOLDERS

### A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

### B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:
  - a. Rockwood (RO).

### C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:
  - a. Norton Rixson (RF).

## 2.13 ARCHITECTURAL SEALS

### A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Manufacturers:
  - 1. Pemko (PE).

#### 2.14 ELECTRONIC ACCESSORIES

- A. Linear Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw plus 50% for the specified electrified hardware and access control equipment.
  - 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
  - 2. Manufacturers:
    - a. Yale Commercial (YA) - BPS Series.

#### 2.15 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

#### 2.16 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 ADJUSTING

- A. Initial Adjusting: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.

- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

**3.6 DEMONSTRATION**

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

**3.7 DOOR HARDWARE SETS**

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
  - 1. Quantities listed are for each pair of doors, or for each single door.
  - 2. The supplier is responsible for handing and sizing all products.
  - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
  - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Manufacturer's Abbreviations:
  - 1. MK - McKinney
  - 2. MR - Markar
  - 3. SU - Securitron
  - 4. RO - Rockwood
  - 5. YA - Yale
  - 6. AD - Adams Rite
  - 7. RF - Rixson
  - 8. PE - Pemko
  - 9. OT - Other

**Hardware Sets**

**Set: 1.0**

Doors: 108B, 109D

0 All Hardware	BY DOOR SUPPLIER		OT
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**Set: 2.0**

Doors: 101A

1 Continuous Hinge	FM100 - DOOR HEIGHT	628	MR
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1	Continuous Hinge	FM100 CTP - DOOR HEIGHT	628	MR
1	Electric Power Transfer	EL-CEPT		SU
1	Mullion	KRM200 - DOOR HEIGHT	600	YA
1	Rim Exit Device, Exit Only	7200 EO	630	YA
1	Rim Exit Device, Nightlatch	7205 MELR 121NL K825xCT7LL K845xCT7LL	630	YA
3	Cylinder Core	K800	626	YA
1	Mortise Cylinder	K825xCT7LL	626	YA
1	Door Pull	BF158 Mtg-Type 12HD	US32D	RO
2	Conc Overhead Stop	6-X36	630	RF
2	Drop Plate (TJ)	486	689	YA
2	Surface Closer	TJ4400	689	YA
1	Threshold	271A MSES25SS		PE
1	Gasketing (mullion)	5110BL		PE
2	Sweep (w/drip edge)	3452CNB		PE
1	Frame Harness	QC-C1500P		MK
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK
1	Card Reader	BY SECURITY		OT
2	Door Position Switch	BY SECURITY		OT
1	Motion Sensor (REX)	BY SECURITY		OT
1	Power Supply	BPS-24-1		YA

Notes:

- Electronic Operation: Valid card retracts latchbolt; key retracts latchbolt. Free egress at all times. In case of power loss or fire alarm (if rated), door remains locked and latched.

**Set: 3.0**

Doors: E-1, S-1, S-2, S-3

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Rim Exit Device, Nightlatch	7100 AU627F K845xCT7LL	630	YA
1	Cylinder Core	K800	626	YA
1	Surface Closer	4430	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
1	Sweep (w/drip edge)	3452CNB		PE
1	Door Position Switch	BY SECURITY		OT

**Set: 4.0**

Doors: 110

6	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt (manual)	555 (or) 557	US26D	RO
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
2	Surface Closer	4430T	689	YA
2	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	271A MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
2	Sweep (w/drip edge)	3452CNB		PE
1	Astragal	357SP		PE
1	Astragal	S771C		PE
2	Door Position Switch	BY SECURITY		OT

**Set: 5.0**

Doors: S-4

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
1	Surface Closer	4430	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
1	Sweep (w/drip edge)	3452CNB		PE
1	Door Position Switch	BY SECURITY		OT

**Set: 6.0**

Doors: 201

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Passage Latch	AU 5401LN	626	YA
1	Deadbolt (dbl cylinder)	D122 Temp Core-7 pin	626	YA
2	Cylinder Core	K800	626	YA
1	Surface Closer	4430	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
1	Sweep (w/drip edge)	3452CNB		PE
1	Door Position Switch	BY SECURITY		OT

**Set: 7.0**

Doors: 108A, 109C

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Intruder Classroom Lock	AU 5418LN	626	YA
2	Cylinder Core	K800	626	YA
1	Surface Closer	4430	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
1	Sweep (w/drip edge)	3452CNB		PE
1	Door Position Switch	BY SECURITY		OT

**Set: 8.0**

Doors: 101B, 101C

1	Continuous Hinge	FM100 - DOOR HEIGHT	628	MR
1	Mortise Lock	2190 1 628 1-Exterior Trim 03-Square	US32D	AD
2	Cylinder Core	K800	626	YA
2	Mortise Cylinder	K825xCT7LL	626	YA
1	Drop Plate (PA)	488	689	YA
1	Blade Stop Spacer	891	689	YA
1	Surface Closer	4430	689	YA

Notes:

- Perimeter/meeting stile seals by frame/door supplier.

**Set: 9.0**

Doors: 203

6	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt (manual)	555 (or) 557	US26D	RO
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
2	Surf Overhead Stop	10-X36	652	RF
2	Silencer	608 (or) 609		RO

**Set: 10.0**

Doors: 202



3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
3	Silencer	608 (or) 609		RO

**Set: 11.0**

Doors: 109A, 109B

3	Hinge, Full Mortise	TA2314 4-1/2" x 4-1/2"	US32D	MK
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
1	Surface Closer	4420	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold (5/16" hgt)	166A MSES10SS		PE
1	Gasketing (head/jamb)	S88BL		PE
1	Sweep	315CN		PE

**Set: 12.0**

Doors: 106

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
1	Surface Closer	4400 (or) PA4400	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
1	Gasketing (head/jamb)	S88BL		PE

**Set: 13.0**

Doors: 103

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	AU 5405LN Temp Core-7 pin	626	YA
1	Cylinder Core	K800	626	YA
1	Surface Closer	4420	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Gasketing (head/jamb)	S88BL		PE

**Set: 14.0**

Doors: 104B

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
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1	Intruder Classroom Lock	AU 5418LN	626	YA
2	Cylinder Core	K800	626	YA
1	Surface Closer	4400 (or) PA4400	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
3	Silencer	608 (or) 609		RO

**Set: 15.0**

Doors: 104A

3	Hinge, Full Mortise	TA2314 4-1/2" x 4-1/2"	US32D	MK
1	Intruder Classroom Lock	AU 5418LN	626	YA
2	Cylinder Core	K800	626	YA
1	Surface Closer	4400 (or) PA4400	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
1	Threshold (5/16" hgt)	166A MSES10SS		PE
1	Gasketing (head/jamb)	S88BL		PE
1	Sweep	315CN		PE

**Set: 16.0**

Doors: 108C

3	Hinge, Full Mortise	TA2314 4-1/2" x 4-1/2"	US32D	MK
1	Intruder Classroom Lock	AU 5418LN	626	YA
2	Cylinder Core	K800	626	YA
1	Surface Closer	4420	689	YA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold (5/16" hgt)	166A MSES10SS		PE
1	Gasketing (head/jamb)	S88BL		PE
1	Sweep	315CN		PE

**Set: 17.0**

Doors: T-1, T-2

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Privacy Lock	AU 5402LN	626	YA
1	Surface Closer	4400 (or) PA4400	689	YA
1	Mop Plate	K1050 4" CSK BEV	US32D	RO
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
1	Gasketing (head/jamb)	S88BL		PE

**Set: 18.0**

Doors: 104C

6	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt (manual)	555 (or) 557	US26D	RO
2	Dummy Trim	AU 455LN	626	YA
1	Deadbolt (classroom)	D162 Temp Core-7 pin	626	YA
1	Magnetic Catch	901	ALM	RO
1	Cylinder Core	K800	626	YA
2	Surf Overhead Stop	10-X36	652	RF
2	Silencer	608 (or) 609		RO

**Set: 19.0**

Doors: 10, 105, 107, 8

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Door Pull	BF Y 110-RKW Mtg-Type 1	US32D	RO
1	Push Plate	70F (8 x 16)	US32D	RO
1	Surface Closer	4400 (or) PA4400	689	YA
1	Mop Plate	K1050 4" CSK BEV	US32D	RO
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Door Stop (wall / floor)	403 (or) 441CU	US26D	RO
3	Silencer	608 (or) 609		RO

END OF SECTION 087100

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulating glass.
  - 2. Laminated glass.

#### 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### 1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
  - 1. Insulating glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Sample Warranties: For special warranties.

#### 1.8 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 2 for basic protection.
1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
  2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  2. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  3. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
  4. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

### 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.

### 2.4 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
    - a. **Basis-of-Design Product:** Subject to compliance with requirements, provide Vitro Architectural Glass; Solarban 60 Solar Control Low-E Glass; Clear + Clear, or comparable product by one of the following:
      - 1) Saint-Gobain Glass Corp.
      - 2) [Technoform Glass Insulation North America](#).
      - 3) [Thermix; a brand of Ensinger USA](#).
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

### 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 2. Interlayer Color: Clear unless otherwise indicated.

### 2.6 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates,

- under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

## 2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep systems.
  3. Minimum required face and edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- H. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Clear Insulating Glass Type <IG>:
  - 1. Overall Unit Thickness: 1 inch (25 mm).
  - 2. Minimum Thickness of Each Glass Lite: 6 mm.
  - 3. Outdoor Lite: Annealed float glass.
  - 4. Interspace Content: Argon.
  - 5. Indoor Lite: Annealed float glass.
  - 6. Low-E Coating: Sputtered on second surface.
  - 7. Winter Nighttime U-Factor: 0.29 maximum.
  - 8. Summer Daytime U-Factor: 0.27 maximum.
  - 9. Visible Light Transmittance: 70 percent minimum.
  - 10. SGHC: 0.39 maximum.

END OF SECTION 088000



## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Gypsum ceiling board.
  - 2. Mold-resistant gypsum board.
  - 3. Grid suspension system for gypsum board ceilings.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. Certainteed; SAINT-GOBAIN.
  - c. [Georgia-Pacific Gypsum LLC](#).
  - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
  - e. PABCO Gypsum.
2. Thickness: **1/2 inch (12.7 mm)**.
3. Long Edges: Tapered.

- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. Certainteed; SAINT-GOBAIN.
  - c. [Georgia-Pacific Gypsum LLC](#).
  - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
  - e. [PABCO Gypsum](#).
  - f. PABCO Gypsum.
  - g. USG Corporation.
2. Core: **1/2 inch (12.7 mm)**, regular type.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

- C. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong Ceiling & Wall Solutions.
  - b. Certainteed; SAINT-GOBAIN.
  - c. USG Corporation.

## 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Ceiling Type: As indicated on Drawings.
  - 2. Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

### 3.4 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Where indicated on Drawings.
  - 3. Level 3: Gypsum board ceilings.

### 3.5 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900





## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

#### 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Build mockup of typical ceiling area as shown on Drawings.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: Class A according to ASTM E1264.
  2. Smoke-Developed Index: 50 or less.

### 2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions ; 'School Zone – FINE FISSURED #1811". or a comparable product by one of the following:
1. American Gypsum.
  2. Certaineed; SAINT-GOBAIN.
  3. Rockfon; ROCKWOOL International.
  4. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.85.
- F. Ceiling Attenuation Class (CAC): Not less than 35.
- G. Noise Reduction Coefficient (NRC): Not less than 0.70.
- H. Edge/Joint Detail: Square.
- I. Thickness: **3/4 inch (19 mm).**
- J. Modular Size: **24 by 48 inches (610 by 1220 mm).**
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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 D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

### 2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions ; "Prelude XL". or a comparable product by one of the following:
1. Certaineed; SAINT-GOBAIN.
  2. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip

galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Painted white

## 2.5 ACCESSORIES

A. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- (3.5-mm-) diameter wire.

## 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 unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure 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. 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.
  6. 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.
  7. Do not attach hangers to steel deck tabs.
  8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  9. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
  10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 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 suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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 precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
- 3.4 ERECTION TOLERANCES
- A. Suspended Ceilings: Install main and cross runners level to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)**, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Concrete
- 2. Concrete Masonry Unit (CMU)
- 3. Steel, including dry-fall system for overhead steel.
- 4. Finish Carpentry.
- 5. Gypsum Board

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
- 2. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
- 3. Section 081113 "Hollow Metal Doors and Frames"
- 4. Section 092900 "Gypsum Board"

#### 1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.



1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions, including preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
  - 3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint Products: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Benjamin Moore & Co.
  - 2. Coronado Paint; Benjamin Moore & Co.
  - 3. PPG Paints; PPG Industries, Inc.
  - 4. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
  - 5. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
  - 6. Sherwin-Williams Company (The).
  - 7. Valspar; a brand of The Sherwin-Williams Company.
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of

colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

1. Twenty percent of surface area will be painted with deep tones.

E. See Interior Painting Schedule in Part 3 for Product Designations and Paint Systems.

### 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. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 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 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 if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. 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.

### 3.3 INSTALLATION

- 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 equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Tanks that do not have factory-applied final finishes.
  - 2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.

### 3.4 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.
  - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.

2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
  4. Collect waste paint by type and deliver to recycling or collection facility.
- 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 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System:
  - a. Use at corridors, classrooms, locker rooms, storage rooms, and other miscellaneous spaces with CMU wall surfaces scheduled to receive new paint finish.
  - b. Block Filler: Interior/exterior latex block filler, MPI #4.
    - 1) At previously painted CMU substrates: Delete Block Filler from paint systems listed.
  - c. Intermediate Coat: Interior, Latex, institutional low odor/VOC Matching topcoat.
  - d. Topcoat: Interior, latex, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.

B. Steel Substrates:

1. Water-Based Dry-Fall System:
  - a. Apply at underside of roof deck and framing in any portions of the areas of work that are not covered by gypsum board or acoustic panel ceilings.
  - b. Prime Coat
    - 1) Dry fall, latex, flat, over original shop primer or previously applied paint system to existing steel structure, MPI #118.
    - 2) Prime Coat for Galvanized Steel: Dry fall, water based, for galvanized steel, flat (Gloss Level 1), MPI #133.
  - c. Topcoat:
    - 1) Dry fall, latex, flat, MPI #118.
    - 2) Dry fall, water based, for galvanized steel, flat (Gloss Level 1), MPI #133.
2. Institutional Low-Odor/VOC Latex System:
  - a. Apply at miscellaneous steel substrates scheduled for painted finish such as panelboards, pipes, conduits, etc.
  - b. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
  - c. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

3. High-Performance Architectural Latex System:
  - a. Apply at steel door frames, doors, borrowed lite frames, and similar steel finishes.
  - b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79 or primer, alkyd, quick dry, for metal, MPI #76.
  - c. Prime Coat: Shop primer specified in Section where substrate is specified.
  - d. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  - e. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.
  
- C. Finish Carpentry: Including wood trim, architectural woodwork, wood-based panel products where scheduled for opaque finish in project documents.
  1. High-Performance Architectural Latex System:
    - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    - b. Prime coat not required on previously painted surfaces.
    - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
    - d. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.
  
- D. Gypsum Board Substrates:
  1. Apply to underside of gypsum board ceilings scheduled.
  2. Institutional Low-Odor/VOC Latex System:
    - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
      - 1) Prime Coat not required on previously painted surfaces.
    - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

END OF SECTION 099123

## SECTION 099600 - HIGH-PERFORMANCE COATINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
  - 1. Exterior Substrates:
    - a. Exposed Structural Steel.
    - b. Galvanized structural steel or metal.
  - 2. Interior Substrates
    - a. Concrete Slab
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.
  - 2. Section 099123 "Interior Painting" for general field painting.

#### 1.3 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product indicated.



- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
    - a. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acrymax Technologies, Inc.
  - 2. Benjamin Moore & Company.
  - 3. PPG Paints.
  - 4. Sherwin-Williams Company (The).
  - 5. Tnemec, Inc.
- B. Products: Basis of Design products are identified in the Exterior High-Performance Coating Schedule. Subject to compliance with requirements, products by other manufacturers listed above may be provided with prior approval by Architect.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated.
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. 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 coating 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 if any.
- C. Clean substrates of substances that could impair bond of coatings, 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 coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  1. SSPC-SP 6/NACE No. 3.

- E. 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.
- F. 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 coatings.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for coating and substrate indicated.
  - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass 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 coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating 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 coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

### 3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

#### A. Structural Steel Substrates:

- 1. Apply coating to Tubular and Structural Steel at exterior canopies and signage.
- 2. Epoxy System MPI EXT 5.1S – G6:
  - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #120.
  - b. Intermediate Coat: Epoxy, matching topcoat.
  - c. Topcoat: Epoxy, gloss level 7, MPI #77.
    - 1) Sherwin Williams Co.; High Performance Epoxy.
    - 2) PPG Paints; HPC High Gloss Polyamine Epoxy
    - 3) Tnemec Co., Inc.; Modified Polyamine Epoxy

#### B. Galvanized-Metal Substrates:

- 1. Apply coating to exposed sides of roof deck at exterior canopies.
- 2. Epoxy System MPI EXT 5.3C:
  - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
  - b. Intermediate Coat: Epoxy, matching topcoat.
  - c. Topcoat: Epoxy, gloss level 7, MPI #77.
    - 1) Sherwin Williams Co.; High Performance Epoxy.
    - 2) PPG Paints; HPC High Gloss Polyamine Epoxy
    - 3) Tnemec Co., Inc.; Modified Polyamine Epoxy

### 3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

#### A. Concrete Slab Substrates

- 1. Apply coating to entire surface of exposed concrete slab as shown on drawings.
- 2. Floor Paint MPI #60
  - a. Prime: Per manufacture requirements.
  - b. Top Coat: Latex, Low Gloss

- 1) PPG Architectural; Dulux Water-Based Polyurethane Floor Enamel
- 2) Sherwin-Williams Co.; Armorseal Tread Plex

END OF SECTION 099600



## SECTION 101100 - VISUAL DISPLAY UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Visual display board assemblies.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
  - 1. Samples of facings for each visual display panel type, indicating color and texture.
  - 2. Fabric swatches of fabric facings for tackboards.
  - 3. Actual factory-finish color samples, applied to aluminum substrate.
  - 4. Include accessory Samples to verify color selected.
- C. Product Schedule: For visual display units.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For manufacturer's special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.



1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY: Wall Mounted tack Boards

- 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. [AJW Architectural Products.](#)
  - 2. [ASI Visual Display Products.](#)
  - 3. [Aarco Products, Inc.](#)
  - 4. [Claridge Products and Equipment, Inc.](#)
- B. Visual Display Board Assembly: factory fabricated.
  - 1. Assembly: tackboard.
  - 2. Corners: Square.
  - 3. Width: As indicated on Drawings.
  - 4. Height: As indicated on Drawings.
  - 5. Mounting Method: Direct to wall.
- C. Tackboard Panel: Vinyl-fabric-faced tackboard panel on core indicated.
  - 1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
  - 2. Color and Pattern: As selected by Architect from full range of industry colors.
- D. Aluminum Frames: Fabricated from not less than **0.062-inch- (1.57-mm-)** thick, extruded aluminum; standard size and shape.

1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
2. Aluminum Finish: Clear anodic finish.

### 2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
1. Face Sheet Thickness: 0.021 inch (0.53 mm) uncoated base metal thickness.
  2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
  3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

### 2.4 TACKBOARD PANELS

- A. Tackboard Panels:
1. Facing: Vinyl fabric factory laminated to 1/16-inch- (1.6-mm-) thick, cork sheet.
  2. Core: Manufacturer's standard.
  3. Core: 1/4-inch- (6-mm-) thick hardboard or particleboard.

### 2.5 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. High-Pressure Decorative Laminate: NEMA LD 3.
- C. High-Pressure Markerboard Laminate: Complying with physical testing requirements of NEMA LD 3.
- D. Vinyl Fabric: Mildew resistant, washable, complying with ASTM F793/F793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface-burning characteristics indicated.
- E. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. ( )yd. (508 g/sq. m); with surface-burning characteristics indicated.
- F. Hardboard: ANSI A135.4, tempered.
- G. Particleboard: ANSI A208.1, Grade M-1.
- H. MDF: ANSI A208.2, Grade 130.
- I. Fiberboard: ASTM C208 cellulosic fiber insulating board.
- J. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6063.

- K. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prepare recesses for sliding visual display units as required by type and size of unit.

### 3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than **16 inches (400 mm)** o.c. Secure tops and bottoms of boards to walls.

### 3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100



## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Public-use washroom accessories.
  2. Underlavatory guards.
  3. Custodial accessories.

#### 1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
  2. Identify accessories using designations indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

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

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials:
  - 1. Paper Towel Dispenser
  - 2. Toilet Paper Dispenser
  - 3. Soap Dispenser

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist **250 lbf (1112 N)** concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Waste Receptacle:
  - 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. [AJW Architectural Products.](#)
    - b. [ASI-American Specialties, Inc.](#)
    - c. [Bobrick Washroom Equipment, Inc.](#)
    - d. [Bradley Corporation.](#)

2. Mounting: Surface mounted.
3. Minimum Capacity: 12 gallon.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Liner: Reusable vinyl liner.
6. Lockset: Tumbler type for waste receptacle.

C. Grab Bar:

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. [AJW Architectural Products.](#)
  - b. [ASI-American Specialties, Inc.](#)
  - c. [Bobrick Washroom Equipment, Inc.](#)
  - d. [Bradley Corporation.](#)
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
  - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

D. Mirror Unit:

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. [AJW Architectural Products.](#)
  - b. [ASI-American Specialties, Inc.](#)
  - c. [Bobrick Washroom Equipment, Inc.](#)
  - d. [Bradley Corporation.](#)
2. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick.
  - a. Corners: Welded and ground smooth.
3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

## 2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

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. [Buckaroos, Inc.](#)
  - b. [Plumberex Specialty Products, Inc.](#)
  - c. [Truebro; IPS Corporation.](#)
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
  3. Material and Finish: Antimicrobial, molded plastic, white.

## 2.5 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
- B. Custodial Mop and Broom Holder:
  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. [AJW Architectural Products.](#)
    - b. [ASI-American Specialties, Inc.](#)
    - c. [Bobrick Washroom Equipment, Inc.](#)
    - d. [Bradley Corporation.](#)
  2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
  3. Length: **36 inches (914 mm)**.
  4. Hooks: Four.
  5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
  6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
    - a. Shelf: Not less than nominal **0.05-inch- (1.3-mm-)** thick stainless steel.
    - b. Rod: Approximately **1/4-inch- (6-mm-)** diameter stainless steel.

## 2.6 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, **0.031-inch- (0.8-mm-)** minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), **0.036-inch- (0.9-mm-)** minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with **G60 (Z180)** hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800



## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each and mounting bracket indicated.
  - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [Babcock-Davis](#).
    - b. [Badger Fire Protection; a Carrier company](#).
    - c. [Buckeye Fire Equipment Company](#).
    - d. [Guardian Fire Equipment, Inc.](#)
    - e. [J. L. Industries, Inc.; Activar Construction Products Group, Inc.](#)
    - f. [Kidde; Carrier Global Corporation](#).
    - g. [Larsen's Manufacturing Company](#).
  - 2. Source Limitations: Obtain fire extinguishers and accessories, from single source from single manufacturer.
  - 3. Valves: Manufacturer's standard.
  - 4. Handles and Levers: Manufacturer's standard.
  - 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B
- B. Multipurpose Dry-Chemical Type: UL-rated 10 MP nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
  - 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
  - a. Orientation: Vertical.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416



## SECTION 105113 - METAL LOCKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Welded lockers.
  - 2. Locker benches.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show locker trim and accessories.
  - 3. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.



1.7 COORDINATION

- A. Coordinate sizes and locations of concrete masonry bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of latches and other door hardware.
  - 2. Damage from deliberate destruction and vandalism is excluded.
  - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.
  - 4. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers[, locker benches,] and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 WELDED CORRIDOR LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Penco Products, Inc; Guardian Knocked Down Steel Lockers; or a comparable product by one of the following:
  - 1. ASI Storage Solutions.
  - 2. Art Metal Products.
  - 3. GSS Lockers.
  - 4. LockersMFG.
  - 5. Olympus Lockers & Storage Products, Inc.
  - 6. Republic Storage Systems, LLC.
  - 7. Top Tier Storage Products.

8. [WEC Manufacturing LLC.](#)
- B. Doors: One piece; fabricated from **0.075-inch (1.90-mm)** nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
  1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than **15 inches (381 mm)** wide; welded to inner face of doors.
  2. Door Style: Vented panel as follows:
    - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
  1. Tops, Bottoms, and Sides: **0.060-inch (1.52-mm)** nominal thickness.
  2. Backs: **0.048-inch (1.21-mm)** nominal thickness.
  3. Shelves: **0.060-inch (1.52-mm)** nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from **0.060-inch (1.52-mm)** nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
  1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
- E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
  1. Hinges: Manufacturer's standard, steel, continuous or knuckle type.
- F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
  1. Single-Point Latching: Nonmoving latch hook with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
    - a. Latch Hook: Equip each door with one latch hook, fabricated from **0.120-inch (3.04-mm)** nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.
- G. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- H. Coat Rods: **1-inch- (25-mm-)** diameter steel, chrome finished.
- I. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than **0.060-inch (1.52-mm)** nominal-thickness steel sheet.
  1. Height: **4 inches (102 mm)**.
- J. Recess Trim: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.

- K. Filler Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- L. Boxed End Panels: Fabricated from **0.048-inch (1.21-mm)** nominal-thickness steel sheet.
- M. Finished End Panels: Fabricated from **0.024-inch (0.61-mm)** nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- N. Finish: Baked enamel or powder coat.
  - 1. Color: As selected by Architect from manufacturer's full range.

## 2.4 LOCKER BENCHES

- 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. [AJW Architectural Products.](#)
  - 2. [ASI Storage Solutions.](#)
  - 3. [List Industries Inc.](#)
  - 4. [Lyon LLC.](#)
  - 5. [Penco Products, Inc.](#)
  - 6. [Top Tier Storage Products.](#)
- B. Provide bench units with overall assembly height of **17-1/2 inches (445 mm)**.
- C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
  - 1. Size: Minimum **9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick)** except provide **20- to 24-inch- (508- to 610-mm-)** wide tops where accessible benches are indicated.
  - 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
- D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:
  - 1. Tubular Steel:
    - a. **1-1/2-inch- (38-mm-)** diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

## 2.5 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
  - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.

- 
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
  - C. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
  - D. Accessible Lockers: Fabricate as follows:
    1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
    2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
  - E. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
  - F. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.
  - G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
  - H. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
    1. Provide one-piece panels for double-row (back-to-back) locker ends.
  - I. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
    1. Provide one-piece panels for double-row (back-to-back) locker ends.
  - J. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.
- 2.6 ACCESSORIES
- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
  - B. Anchors: Material, type, and size required for secure anchorage to each substrate.
    1. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
  - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than **36 inches (910 mm)** o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  - 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
- B. Equipment:
  - 1. Attach hooks with at least two fasteners.
  - 2. Attach door locks on doors using security-type fasteners.
- C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  - 1. Attach recess trim to recessed metal lockers with concealed clips.
  - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
  - 3. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
  - 4. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than **72 inches (1830 mm)** apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

### 3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113



**SECTION 107313 - AWNINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Cantilever awnings.

**1.2 ACTION SUBMITTALS**

**A. Product Data: For each type of product.**

1. Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, and finishes for awnings.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**B. Shop Drawings:**

1. Include plans, elevations, sections, mounting heights, and attachment details.
2. Detail fabrication and assembly of awnings.
3. Show locations for blocking, reinforcement, and supplementary structural support.

**1.3 INFORMATIONAL SUBMITTALS**

**A. Sample Warranty: For special warranty.**

**1.4 CLOSEOUT SUBMITTALS**

**A. Operation and Maintenance Data: For awnings to include in operation and maintenance manuals.**

**1.5 QUALITY ASSURANCE**

**A. Installer Qualifications: Fabricator of products.**

**1.6 WARRANTY**

**A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.**

1. Failures include, but are not limited to, the following:



- a. Structural failures including framework.
  - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Awning Warranty Period: **Five** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: **120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.**

### 2.2 FIXED AWNINGS

- A. Cantilever Awning:
1. Basis of Design Product: Subject to compliance with requirements, provide Mapes Architectural Canopies; Cantilever Canopy, or a comparable product.
  2. Description:
    - a. Material: Extruded Aluminum (T6-6063)
    - b. Fascia Option: 8 inch – J x .125" Thick.
    - c. Decking Option: 2 3/4" x .078" Thick.
    - d. Deflection Rating: L/180
    - e. Maximum Projection: 60 inches with cantilever supports.
- B. Aluminum Finish: **Baked-enamel or powder-coat** finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
1. Color: **As selected by Architect from manufacturer's full range.**

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General: Install awnings at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.
- B. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- C. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and in a manner that prevents exterior moisture from passing through completed exterior wall and roof assemblies.

**3.3 CLEANING AND PROTECTION**

- A. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 107313



## SECTION 123661.16 - SOLID SURFACING MATERIALS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Solid surface material windowsills.

#### 1.3 ACTION SUBMITTALS

- A. Samples for Initial Selection: For each type of material exposed to view.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

#### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of windowsills by field measurements after windows are installed.

## PART 2 - PRODUCTS

### 2.1 SOLID SURFACE WINDOWSILL MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Affinity Surfaces; a brand of Domain Industries, Inc.
    - b. Avonite Surfaces.
    - c. E. I. du Pont de Nemours and Company.
    - d. Formica Corporation.
    - e. Meganite Inc.
    - f. Swan Corporation (The).
    - g. Wilsonart.
    - h. Other manufacturer's products may be considered with prior approval by Architect.
  - 2. Type: Provide Standard type unless Special Purpose type is indicated.
  - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
    - a. Selections to be made from manufacturer's mid-range price categories. (i.e. Corian's groups B and C)

### 2.2 WINDOWSILL FABRICATION

- A. Fabricate windowsills according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  - 1. Grade: Custom.
- B. Configuration:
  - 1. See drawings for details.
- C. Windowsills: 3/4-inch- (19-mm-) thick, solid surface material with front edge built up with same material.
- D. Joints: Fabricate windowsills without joints unless lengths require joining.

### 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Windowsills: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

**3.1 EXAMINATION**

- A. Examine substrates to receive solid surface material windowsills and conditions under which windowsills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install windowsills level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Secure windowsills with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16



**SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY OF WORK**

- A. The Fire Suppression Contractor shall provide a complete and fully operational fire protection system including but not limited to the following:
  - 1. All pipes, fittings, specialties, fire-protection valves, fire-department connections and other specialties.
  - 2. Sprinklers Heads.
  - 3. Piping Supports.
  - 4. Alarm devices, manual control stations and control panels.
- B. Provide a code compliant hydraulically designed fire suppression system. The drawings indicate sprinkler head locations with the heads shown to demonstrate the general layout of the fire suppression system. In any areas where sprinkler heads are required and not indicated, the heads shall be provided at no additional cost.

**1.3 SUBMITTALS**

- A. The Fire Suppression Contractor is required to submit working construction documents including plans, elevations, sections and attachment details for review by the Architect, Engineer, and applicable local code officials. The submittal shall conform to the requirements of the 2015 International Fire Code. The construction documents shall be prepared by a registered design professional, as required by the local code official, and submitted in such form and detail as required by the local jurisdiction.
- B. Provide hydraulic calculations using water flow test data obtained from the local water utility company. If recent flow test data is not available (less than 6 months old) arrange for a water flow test before preparing the design. Use the test data to size the piping system and all components.
- C. Product Data: For each type of product. Include rated capacities, operating
- D. Characteristics, electrical characteristics, and furnished specialties and accessories.
- E. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.



1.4 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
  - 1. Notify Owner's representative a minimum of 7 days in advance of proposed interruption of sprinkler service.
  - 2. Do not proceed with interruption of sprinkler service without written permission.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. System Design: Design sprinkler system(s), including comprehensive engineering hydraulic calculations by a qualified design professional, using performance requirements, design criteria and flow test data indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: **10** percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1.
    - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - e. Classroom, Office and Public Areas: Light Hazard.
    - f. Machine Shops: Ordinary Hazard Group 2.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
  - 4. Maximum Protection Area per Sprinkler: Per UL listing.
  - 5. Maximum Protection Area per Sprinkler: Per NFPA 13 recommendations unless otherwise indicated.

1.6 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. The system shall conform to the requirements of the 2015 International Fire Code with local jurisdiction amendments.

- C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

- 1. NFPA 13.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction components including ducts, piping, electrical work and all items that penetrate ceilings, including light fixtures, HVAC equipment, and partition assemblies. Refer to the requirements for Coordination Drawings in Division 01 Sections and in Section 220010.
- B. Coordinate layout and installation of sprinklers with other construction that penetrate ceilings, including light fixtures, HVAC equipment, and partition assemblies. Refer to the requirements

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article, in Part 3, for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

#### 2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 black-steel Pipe: ASTM A 53. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 40 black steel Pipe Nipples: ASTM A 733, made of ASTM A 53/, standard-weight, seamless steel pipe with threaded ends.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- D. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- E. Schedule 40 Grooved-Joint, Steel-Pipe and fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
  - 1. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

2.5 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
  - 3. Minimum Pressure Rating for High-Pressure Piping: 300 psig.
- B. Ball Valves:
  - 1. Manufacturers: Subject to compliance with code requirements provide products by one of the following.
    - a. Anvil International, Inc.
    - b. Victaulic Company.
    - c. NIBCO.
  - 2. Standard: UL 1091 except with ball instead of disc.
  - 3. Valves NPS 2 and Smaller: Bronze body with threaded ends.
- C. Bronze Butterfly Valves:
  - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
    - a. Fivalco Inc.
    - b. Global Safety Products, Inc.
    - c. Milwaukee Valve Company.

- d. Victaulic.
  - 2. Standard: UL 1091.
  - 3. Pressure Rating: 175 psig.
  - 4. Body Material: Bronze.
  - 5. End Connections: Threaded.
- D. Iron Butterfly Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Anvil International, Inc.
    - b. Global Safety Products, Inc.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Tyco Fire & Building Products LP.
    - f. Victaulic Company.
  - 2. Standard: UL 1091.
  - 3. Pressure Rating: 175 psig.
  - 4. Body Material: Cast or ductile iron.
  - 5. Style: Lug or wafer.
  - 6. End Connections: Grooved.
- E. Check Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFAC Inc.
    - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - c. Anvil International, Inc.
    - d. Clow Valve Company; a division of McWane, Inc.
    - e. Crane Co.
    - f. Fire Protection Products, Inc.
    - g. Milwaukee Valve Company.
    - h. Mueller Co.; Water Products Division.
    - i. NIBCO INC.
    - j. Reliable Automatic Sprinkler Co., Inc.
    - k. Tyco Fire & Building Products LP.
    - l. United Brass Works, Inc.
    - m. Victaulic Company.
    - n. Viking Corporation.
    - o. Watts Water Technologies, Inc.
  - 2. Standard: UL 312.
  - 3. Pressure Rating: 250 psig.
  - 4. Type: Swing check.
  - 5. Body Material: Cast iron.
  - 6. End Connections: Flanged or grooved.
- F. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

**G. Iron OS&Y Gate Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. Crane Co.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.
  - i. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

**H. Gate Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Clow Valve Company; a division of McWane, Inc.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Mueller Co.; Water Products Division.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Anvil International, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Fire Protection Products, Inc.
  - d. Flowserve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
  - h. Victaulic Company.
  - i. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Southern Manufacturing Group.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
  - b. High-Pressure Piping Specialty Valves: 250 psig (1725 kPa).
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig (1200 kPa) minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4 (DN 20).
5. End Connections: Threaded.

## 2.8 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlet: Hard-coated aluminum 4" x 5" Storz connection with screen and 90 degree angle pattern adapter locking inlet. Include extension pipe nipples, brass lugged 30 degree adapter and swivel connections, and check devices or clappers.
7. Caps: Hard Coated aluminum, lugged type, with gasket and chain.
8. Number of Inlets: One.
9. Escutcheon Plate Marking: Similar to "AUTO SPKR."

10. 10. Finish: K-Brite aluminum adapter and cap with polished chrome plated sleeve and plate.

B. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR."

1. (1) Type: Flush mounting.
2. (2) Escutcheon Plate: Rectangular.
3. (3) Finish: Polished chrome-plated.

## 2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig.
3. Body Material: Cast- or ductile-iron housing with sight glass.



4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Flex Head Industries, Inc.
  - b. Victaulic Corp.
  - c. Viking Group Inc.
2. Standard: ASTM C635, UL 1474.
3. Type: Braided stainless steel flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig.
5. Size: Same as connected piping, for sprinkler.

2.10 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:
  - a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
  - b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.

E. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.

3. Painted.

F. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Reliable Automatic Sprinkler Co., Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Notifier; a Honeywell company.
  - c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Strobe/Horn:

- a. Standard: UL 464.
- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.

- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."

D. Water-Flow Indicators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. ADT Security Services, Inc.
  - b. McDonnell & Miller; ITT Industries.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Viking Corporation.
  - f. Watts Industries (Canada) Inc.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig (1725 kPa).
- 7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised water-flow switch with retard feature.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.

2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.

#### 2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. AMETEK; U.S. Gauge Division.
  2. Ashcroft, Inc.
  3. Brecco Corporation.
  4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa).
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

#### 2.13 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 250-psig minimum working-pressure rating and ends according to the following:
  1. NPS 2 and Smaller: Threaded.
  2. NPS 2-1/2 and Larger: Flanged or Grooved for use with grooved-end-pipe couplings.
- B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. When required, perform flow test according to NFPA 13 and NFPA 291. Use results for system design calculations. Report test results promptly and in writing.

#### 3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.

- B. Where indicated, install shutoff valve, check valve, pressure gages, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical. Deviations from approved working plans for piping require written approval from authorities having jurisdiction.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Install unions adjacent to each valve in pipes NPS 2 and smaller. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- G. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- H. Install alarm devices in piping systems.
- I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- J. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- K. Fill sprinkler system piping with water.

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

### 3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.
- D. Install guards on exposed sprinklers subject to damage.

### 3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections, verify connection type with Local Fire Department.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

### 3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint.

- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Install sleeves that are large enough to provide annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. Install sleeve materials according to the following applications:
  - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
  - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
    - a. Extend sleeves 2 inches above finished floor level.
    - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Galvanized-steel-sheet.
    - b. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

### 3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.11 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

### 3.12 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.



2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

### 3.13 CLEANING

- A. Clean dirt and debris from sprinklers. Remove and replace sprinklers with paint other than factory finish.

### 3.14 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the fire suppression system.

### 3.15 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Type L, hard copper tube with plain ends; wrought-copper solder-joint fittings; and brazed joints.
5. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger shall be one of the following:

1. Schedule 40, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

- E. Ductile Iron underground. Underground fire-service-main piping NPS 4 to NPS 12 to be the following:

Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical; ductile-iron-pipe appurtenances; joints.

### 3.16 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers or pendant sprinklers. Provide custom color as indicated on the drawings.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers, Pendent, dry sprinklers, Sidewall, dry sprinklers, Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as required.
5. Special Applications: Extended-coverage, quick-response sprinklers where permitted by code.
6. Provide Sprinkler head guards in all areas where heads are exposed to potential damage.

- B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate unless custom color cover plate is required as indicated on the drawings.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
5. Upright, Pendent and Sidewall Sprinklers subject to damage: Provide wire guards.

END OF SECTION 211313



**SECTION 220010 - BASIC REQUIREMENTS – PLUMBING CONSTRUCTION**

**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. This Section includes general administrative and procedural requirements for plumbing system installations. Administrative and procedural requirements are included in this Section and in various Division 1 Sections.

**1.3 PERMITS AND FEES**

- A. Refer to Non-Technical Specifications, General Conditions for information relating to permits and fees.

**1.4 PROJECT SCHEDULE**

- A. Refer applicable Non-technical specification sections for contract completion time and project construction schedule.

**1.5 SHOP DRAWINGS AND SUBMITTALS**

- A. Follow the procedures specified in the Division 01 sections. Also refer to individual sections of the Division 22 specifications for additional shop drawing and Submittal requirements.
- B. It is the responsibility of the contractor to thoroughly review any and all shop drawings prior to submission to the Architect/Engineer. The contractor's review shall include verifying conformance to the project documents. The contractor will also be responsible for verifying the quantities of materials are adequate.
- C. All shop drawings shall be submitted with a cover sheet indicating the name of the project, the Architects and Engineers name, the name of the vendor and the contractor. There must be sufficient space on the title sheet to allow the appropriate stamping by both the Architect and the Engineer. Shop drawings and submittals not conforming to the above may be returned without review.
- D. All shop drawing submittals will include a listing of any and all exceptions to the requirements indicated in the specifications and on the drawings. Where there are no exceptions, the submittals shall indicate such. Submittals that do not have this listing will not be reviewed.

1.6 COORDINATION DRAWINGS

- A. Coordination drawings are required. Refer to applicable Division 01 sections for the work required by this Contractor in preparing Coordination Drawings.

1.7 INSTALLATION ACCESSIBILITY

- A. The installation of all equipment and appurtenances shall be done so that access and clearances meet the requirements of the equipment manufacturer and all applicable codes.

1.8 ACCEPTABLE MANUFACTURES

- A. The design of the mechanical systems is based on the equipment manufacturer indicated on the drawings. Although individual sections of the specifications may list other manufacturers, these manufacturers will be accepted only if the following occurs:
  - 1. Performance, as judged by the engineer, must be equal to the design-based equipment.
  - 2. Operating characteristics, as judged by the engineer, must be identical to those of the design-based equipment.
  - 3. Physical size of the equipment must be such that it can be installed in the available space, maintaining all required clearances for access / maintenance and meet the architectural requirements of the project such as installed height, length, width and operating weight. The contractor shall be responsible for verifying the equipment meets this requirement.
  - 4. The contractor will be responsible for any costs associated with additional supports, changes in electrical wiring, or piping changes that may be required if equipment other than the design based is used.

1.9 RECORD DOCUMENTS

- A. Prepare record documents in accordance with applicable Division 01 sections. In addition to the requirements specified, indicate the following installed conditions:
  - 1. Mains and branches of piping systems, with valves and control devices and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
  - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  - 4. Contract Modifications, actual equipment and materials installed.
  - 5. Record Documents are to be prepared and/or revised to indicate the room names and numbers to be used by the owner after the projects is complete.

1.10 OPERATING AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with applicable Division 01 sections.

1.11 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.
- B. When materials and products are stored on site, provide protection from weather and temperatures that may cause damage to the items.

1.12 EXTRA MATERIALS

- A. Various specification sections may indicate extra materials that are to be provided with the respective equipment. Where indicated the contractor shall provide the required extra materials. If no additional installation is required, the contractor shall forward, to the owner, all extra materials. When forwarding materials obtain a receipt for any materials forwarded.

1.13 WARRANTY

- A. All equipment, material and labor provided by the contractor shall be warranted for a minimum period of one year after the date of substantial completion.

PART 2 - PRODUCTS

- 2.1 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. Obtain equipment shop drawings for the various items that require rough-in.

3.2 INSTALLATIONS

- A. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
  - 2. Verify all dimensions by field measurements.
  - 3. Coordinate requirements for chases slots, and openings in other building components during the progress of construction, to allow for mechanical installations.
  - 4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

6. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
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. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
10. Install systems, materials, and equipment giving right-of-way priority to the systems required to be installed at a specified slope.
11. Seal all places where piping or ducts pass through walls and floors.

### 3.3 CUTTING AND PATCHING

- A. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
  1. Uncover Work to provide for installation of ill-timed Work.
  2. Removal and replacement of defective Work.
  3. Remove and replace Work not conforming to requirements of the Contract Documents.
  4. Remove samples of installed Work as specified for testing.
  5. Install equipment and materials in existing structures.
- B. Upon written instructions from the Architect, uncover and restore work to provide for Architect/Engineer observation of concealed Work.
- C. In areas of the building where new finishes are being provided, the patching required on a surface which is to receive a new finish will be to bring the underlying surface up to the finish required to receive the final finish. This contractor shall coordinate subsurface finish requirements with the finish trade contractor(s).
- D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- E. Patch existing 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.

### 3.4 CLEANING

- A. This contractor shall be required to thoroughly clean all installed equipment, duct work and piping. Cleaning shall be required before substantial completion on any phase of the project. Do not use cleaning materials and agents that are hazardous to health or property or that may damage the finished surfaces.

END OF SECTION 220010

**SECTION 220030 – ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical connections to equipment specified under other Divisions or furnished by Owner.

**1.2 REFERENCES**

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electric Code.

**1.3 COORDINATION**

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Divisions.
  - 1. Should there be a difference between the design and the installed equipment; change orders shall only be paid for the difference in the rough-ins. If the Division 26 Contractor installs any rough-ins prior to requesting and receiving shop drawings for the equipment to be installed, and the equipment is different than designed, the required rework shall be performed at no additional cost to the owner aside from the difference is cost between the design documents and installed equipment.
  - 2. Should there be a need to install rough-ins ahead of equipment review and final shop drawing, the Division 26 Contractor shall submit a Request for Information, outlining the equipment to be fed, and how the schedule is impacted for review by the Engineer, Architect, Owner and Owner's Representative.
- B. Determined connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

**PART 2 - PRODUCTS**

**2.1 CORDS AND CAPS**

- A. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- B. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- C. Cord Size: Same as rating of branch circuit overcurrent protection.



**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
- B. The Contractor shall be responsible to coordinate all electrical which are installed for roof top equipment. Refer to "Coordination" in Section 260010 for additional requirements.

**3.2 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

**3.3 ELECTRICAL CONNECTIONS**

- A. Electrical connections shall meet equipment manufacturer's instructions.
- B. Conduit connections to equipment shall use flexible conduit. Liquidtight flexible conduit with watertight connectors shall be used in damp or wet locations.
- C. Wiring connections shall use wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Receptacle outlets shall be used where connection with attachment plug is indicated. Where attachment plug is required, equipment shall have a cord and cap.
- E. Suitable strain-relief clamps and fittings shall be used for cord connections at outlet boxes and equipment connection boxes.
- F. Disconnect switches, controllers, control stations, and control devices shall be located as indicated and per NEC requirements.
- G. Verify proper rotation of three phase equipment.
- H. Where applicable, power wiring shall be extended through external disconnect switches, local control switches, remote mounted control panels, etc. and connected to terminals in the equipment.
- I. Where applicable, wire and conduit shall be extended between control device (start/stop pushbuttons or lighted handle switch) and combination starter/disconnect switches.
- J. Coolers and Freezers: freezer and cooler walls, floors and ceilings shall be cut and sealed around conduit openings.

**3.4 MISCELLANEOUS CONNECTIONS**

- A. Fire alarm, security, data, telephone and other low voltage connections shall be installed as required at equipment.

3.5 CONTRACTOR RESPONSIBILITIES (DIVISION 22 CONTRACT)

A. Tank Water Heater (Gas)

1. 120 volt – 1 phase.
2. Cord and plug for gas water heater shall be provided by the manufacturer.
3. Division 26 Contractor shall furnish and install a receptacle adjacent unit and connect.
4. Any interconnecting wiring shall be by the Division 22 Contractor.
5. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

B. Recirculating Pumps

1. 120 volt – 1 phase.
2. Thermal overload switch (manual starter with thermal protection and hand/auto switch to allow starter control from remote source. Square D class 2510 series with handle guard/lock off attachment mount on or adjacent to equipment) shall be furnished and installed by the Division 26 Contractor. Division 26 Contractor shall install switch adjacent to the unit.
3. Division 26 Contractor shall run power wiring thru overload switch and make one power connection.
4. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

C. Electric Water Cooler

1. 120 volt – 1 phase.
2. Division 26 Contractor shall refer to Electric Water Cooler shop drawings and furnish and install a duplex receptacle contained within the enclosure where applicable, or provide direct connection where cord and plug is not provided.
3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

D. Automatic Wash Fountain / Lavatory sink sensors

1. 120 volt – 1 phase.
2. Power transformer to be furnished by manufacturer. Division 26 contractor to provide receptacle under sink for transformer. Wiring from transformer to unit by the Division 22 Contractor.
3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

E. Automatic Flush Valve Sensors

1. 120 volt – 1 phase.
2. Power transformer to be furnished by manufacturer. Division 26 Contractor to make a single point connection to transformer above accessible ceiling. Wiring from transformer to unit by the Division 22 Contractor.
3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

F. Air Compressor

1. 480 volt – 3 phase.

2. Integral factory wired control panel with starter and thermal overloads shall be provided by the manufacturer.
3. Division 26 Contractor shall provide disconnect at the motor and extend power wiring to terminals in control panel and connect as required.
4. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
5. Provide duplex receptacle adjacent to unit for condensate drain.

G. Air Dryer

1. 120 volt – 1 phase.
2. Factory wired control panel shall with disconnecting means as required.
3. Division 26 Contractor to furnish & install a toggle switch adjacent to unit. Wire thru switch to control panel.
4. Division 26 Contractor shall make one power connection to the control panel.
5. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

H. Sewage Lift Station

1. 480 volt – 3 phase.
2. Factory wired control panel with alternator, combination starters and fused disconnect switches, fused control transformer and all control wiring shall be provided by the Division 22 Contractor.
3. Division 26 Contractor shall make one power connection to the control panel.
4. All control equipment and control wiring associated with this system shall be by the Division 22 Contractor.
5. In addition, the Division 22 Contractor shall connect the power leads (supplied on each motor) to the control panel.
6. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

3.6 CONTRACTOR RESPONSIBILITIES (DIVISION 21 CONTRACT)

A. Tamper and Flow Switches

1. Division 21 Contractor shall furnish and install tamper and flow switches, including all ancillary devices associated with the switches.
2. Division 26 contractor shall provide fire alarm system relay and wire device into fire alarm system.
3. Division 26 Contractor shall wire switches into fire alarm system for monitoring.
4. Any other connections and/or equipment required shall be furnished and installed by the Division 21 Contractor.

3.7 CONTRACTOR RESPONSIBILITIES

A. Shop Equipment

1. Division 22, 23 and 26 Contractors shall furnish all equipment shown and/or required to make final connections to the equipment. Where motors and/or equipment are furnished with loose disconnects and/or starters, the Division 26 Contractor shall install the starters, furnish and install the disconnect (if required or indicated) and shall provide power wiring through the starter and disconnect and shall make final connections to the motor. Division

22 and 23 contractors shall be responsible for all piping and duct work connections required.

B. Shop Equipment Demolition

1. Division 22, 23 and 26 Contractors shall be responsible to disconnect all existing welding and 3D Manufacturing equipment in the existing space for removal/relocation by the General Contractor. Division 22, 23, and 26 contractors shall be responsible to reconnect all existing shop equipment once related to their spaces. All contractors are required to document all existing conditions (piping, ductwork and wiring etc.) of shop equipment to make sure it gets reconnected as was in its original locations.

END OF SECTION 220030



**SECTION 220500 - COMMON WORK REQUIREMENTS - PLUMBING CONSTRUCTION**

**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 materials and methods that are common to various Plumbing Systems.

**1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

**1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.
  - 3. Access Doors.
- 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 all system items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, 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. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### 2.3 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. EpcO Sales, Inc.
    - c. Hart Industries, International, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. EpcO Sales, Inc.
    - c. Watts Industries, Inc.; Water Products Div.



- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150 psi 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 (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.

#### 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Pipe wall penetration seals to be of the modular link type. Seals shall consist of a series of interlocking, molded synthetic rubber links, with heavy-duty plastic pressure plates, and corrosion resistant nuts and bolts. Seals to be designed to provide a hydrostatic seal between the pipe and wall penetration. Seals shall be sized and selected per manufacturer recommendations. Mechanical pipe seals shall be fabricated of an EPDM elastomer for general service and a Nitrile/ Buna-N for hydrocarbon/petroleum-based applications. Provide stainless steel hardware as required.
- B. Steel wall sleeve: Cast in place concrete wall sleeves to be fabricated from galvanized heavy wall welded or seamless carbon steel pipe. All sleeves to have a 2" wide, full perimeter water stop, welded on both sides.
- C. Mechanical pipe seals and wall sleeves shall be manufactured by The Metraflex Company®, or Flexicraft Industries.

#### 2.5 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 water stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

**2.6 ROOF PENETRATIONS**

- A. Provide pre-fabricated roof curb with piping portal for all pipe gas piping penetrations through the roof. Curbs to be manufactured by the Pate Co. or equal.
- B. Roof Curbs with Pipe Portals: Provide prefabricated galvanized steel roof curbs fabricated from minimum 16 gauge steel with welded corners. Curbs to be internally reinforced, factory insulated with 1.5" thick 3 lb. Density fiberboard insulation. Where required provide curbs with wood nailers fastened from the underside of the wood nailer.
- C. Refer to drawing details for the type of curb required for the specified roofing system. Provide curbs with an integral metal cant, stepped integral metal cant raised the thickness of roof insulation or no integral cant, as required to suit the details. Provide curbs to meet the installed curb height as detailed on the drawings.
- D. Pipe portal curb cover furnished with a laminated acrylic coated ABS plastic curb cover with pre-punched holes and molded sealing ring on a collared opening, and an EPDM compression molded cap with stainless steel snap lock clamps. Curbs covers shall be resistant to ozone and ultraviolet rays and shall have a serviceable temperature range of -40 degrees F to positive 250 degrees F. The molded sealing ring on the collared opening and the groove in the rubber cap shall be installed to assure a weather-tight pressure and mechanical seal. The protective rubber caps shall have a serviceable temperature range of -60 degrees F to positive 250 degrees F and shall be resistant to ozone and ultraviolet rays. The conical shaped steps of the nipple shall provide a weatherproof seal around the penetration. The stainless steel snap lock clamps shall provide added protection to guarantee the seal.

**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, Cast-Brass Type: With set screw.
- C. Finish: Polished chrome-plated and Rough brass.

**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.

**2.9 CONCRETE EQUIPMENT BASES**

- A. Minimum compressive strength: 3500 p.s.i. at 28 days.
- B. Minimum cementitious material content: 520 lb/cu. Yd.

2.10 ACCESS DOORS

- A. Manufacturers: Subject to review, provide access doors manufactured by Milcor, Inc or equal.
- B. Description: Steel access doors and frames for installation in masonry and/or drywall/gypsum board assemblies. Provide fire rated access doors when doors are installed in a fire rated assembly.
- C. Frames: minimum 16 gage steel with exposed nominal 1" flange around the perimeter of the unit. Where doors are to be installed in drywall/gypsum board assemblies provide frames with a drywall bead. Doors to be installed in masonry shall be furnished with adjustable metal masonry anchors.
- D. Flush Panel Doors: minimum 14 gage steel with concealed spring or piano hinge(s) with a minimum swing of 175 degrees. Finish to be a factory-applied primer, suitable for field painting. Provide flush cylinder lock with key. Key all locks alike.
- E. Access door schedule: In addition to access door shown on the drawings provide the following access doors to be installed where directed by the architect or engineer:
  - 1. Five 16" x 16" to be installed in drywall/ gypsum construction.
  - 2. Five 16" x 16" to be installed in masonry construction.

2.11 FIRESTOPPING

- A. The contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
- B. Subject to compliance with project requirements, firestopping materials may be provided by one of the following manufacturers:
  - 1. Specified Technologies Inc. (STI) Somerville, NJ.
  - 2. Tremco, Beechwood, OH.
  - 3. 3M, St. Paul MN.
- C. Submit for review the following product data
  - 1. Product data sheets.
  - 2. UL System drawings for each firestopping application
  - 3. Manufacturer's Certificates of Compliance for their products.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss,

expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Maintain unobstructed passageway of not less than 42" in width and 80" minimum head clearance as required by code.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. Install piping to permit valve servicing. Install piping at indicated slopes. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install escutcheons for penetrations of walls, ceilings, and floors.
- J. Sleeves are not required for core-drilled holes.
- K. Permanent sleeves are not required for holes formed by removable sleeves.
- L. 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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) 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 (50 mm) 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.

- M. Seal annular space between sleeve or opening and pipe or pipe insulation, using sealants appropriate for size, depth, and location of joint.
- N. Aboveground and Underground, Exterior-Wall Pipe Penetrations: Provide Mechanical Sleeve Seal and wall sleeve.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and sized per manufacturer's recommendations. Position the 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.
- O. Corrosion Protection: Pipes passing through concrete walls and/or floors and through block walls shall be protected against external corrosion by a protective sheathing or wrapping that will withstand any reaction from wall or floor material.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at all pipe penetrations. Where required seal all pipe penetrations with fire stop materials.
- Q. Roof penetrations: provide roof curbs with pipe portals at all locations where gas piping penetrates the roof.
- 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. 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.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) 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.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- B. Install equipment to maintain unobstructed passageway of not less than 42" in width and 80" minimum head clearance as required by code.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 CONCRETE EQUIPMENT BASES

- A. Provide concrete bases for all floor mounted mechanical equipment unless otherwise noted on the contract drawings.
  - 1. Construct concrete bases with a minimum height of 6" and extend bases not less than 6" larger, in all directions, than supported equipment.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment and according to anchor-bolt manufacturer's written instructions.
  - 6. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project when applicable.

**3.6 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Clean surfaces that will come into contact with grout.
- B. Provide forms as required for placement of grout. Avoid air entrapment during placement of grout. Place grout, completely filling equipment bases. Place grout on concrete bases and provide smooth bearing surface for equipment.
- C. Place grout around anchors. Cure placed grout.

**3.7 INSTALLATION OF PIPING UNDER EXISTING FLOORS**

- A. Where the drawings indicate new piping is to be installed under existing slab-on-grade construction, the installing contractor will be required to verify the location(s) of any existing pipes, conduits or any other system components, that are required to remain in service, before saw cutting existing slabs.

**3.8 ACCESS DOORS**

- A. Comply with manufacturer's written instructions for installing access doors and frames. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces. Install doors flush with adjacent finish surfaces or recessed to receive finish material.
- B. Adjust doors and hardware after installation for proper operation. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 220500

**SECTION 220510 - EXCAVATION FOR PLUMBING CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General Conditions and other Division-22 Specification Sections, apply to this Section.

**1.2 DESCRIPTION OF WORK**

- A. Excavation, backfill and compaction associated with utility construction including such related features as protection of adjacent utilities and structures, maintenance and protection of traffic, cutting paved surfaces, support of excavation, control of excavated materials, de-watering, piping, bedding, disposal of excavated materials, and all work related to providing excavation, backfill and compaction for all utilities and structures in connection with the plumbing systems.

**1.3 QUALITY ASSURANCE**

- A. Testing Agent: Compaction testing for this Work shall be performed by the contractor's Testing Agency. Where compaction testing is specified, such compaction testing shall be performed by a soils testing agent engaged and paid for by the Contractor and approved by the Architect.
- B. Reference Standards:
  - 1. Pennsylvania Department of Transportation:
    - a. Regulations Governing Occupancy of Highways by Utilities (67 PA Code, Chapter 459)
    - b. Publication 408 Specifications Pennsylvania Test Method, PTM 106 Pennsylvania Test Method, PTM 402
    - c. Publication 203, Work Zone Traffic Control
  - 2. American Society for Testing and Materials (ASTM):
    - a. ASTM D698 Test Method for Laboratory Compaction characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft<sup>3</sup>)
    - b. ASTM D2922 Standard Test Method for Density of Soil and Soil - Aggregate in Place by Nuclear Methods (Shallow Depth).
- C. Compaction Testing:
  - 1. Compaction shall be by the testing procedure contained in ASTM D2922 based on previously determined compaction curve data as established by ASTM D698.



1.4 SUBMITTALS

- A. Certificates: Submit certification attesting that the composition analysis of pipe embedment and select material stone backfill materials meet specification requirements.

1.5 JOB CONDITIONS

- A. Permits: Obtain and pay for all permits and inspections required for the work under this Section.
- B. Excavation and Rock Removal:
1. Refer to Earthwork for information relative to removal of rock and classification of excavation. All requirements and classification for excavation, rock removal, earthwork, etc. specified under the Earthwork section shall be made a part of this Section.
- C. Compaction of Backfill:
1. Excavations shall be backfilled with lifts which are individually compacted.
  2. The following compaction densities (based on standard Proctor Curve ASTM D698) shall be achieved:
    - a. Trench Backfill under asphalt and concrete paving (not including base course materials): 100%.
    - b. Trench Backfill within Unpaved Areas: 95%.
    - c. Exterior Side of Structures: 95%.
  3. Contractor shall maintain optimum moisture content of backfill materials to attain the required compaction density.
- D. Protection of Existing Utilities and Structures:
1. Take all precautions and utilize all facilities required to protect existing utilities and structures. In compliance with Act 172 of the General Assembly of Pennsylvania, advise each Utility at least three (3) working days in advance of intent to excavate, do demolition work and give the location of the job site. Request cooperative steps of the Utility and suggestions for procedures to avoid damage to its lines.
  2. Advise each person in physical control of powered equipment or explosives used in excavation or demolition work of the type and location of utility lines at the job site, the Utility assistance to expect, and procedures to follow to prevent damage.
  3. Immediately report to the Utility and the Architect any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of premises of any emergency created or discovered.
  4. Allow free access to Utility personnel at all times for purposes of maintenance, repair and inspection.

1.6 WARRANTY

- A. All equipment, material and labor provided under this specification section shall be warranted for a period of one year after project completion.

PART 2 - PRODUCTS

2.1 DETECTABLE WARNING TAPE

- A. Acid and alkali resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, including storm water, 6" wide, 4 mils thick, continuously inscribed with a description of the utility with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep, colored as directed by authorities having jurisdiction on the project or as directed by the Architect.

2.2 PIPE BEDDING OR EMBEDMENT MATERIAL

- A. PennDOT No. 2A course aggregate, Table C, Section 703.2, Publication 408 Specifications or PennDOT 2RC.

2.3 SLAB OR BASE MATERIAL

- A. Concrete Slab or Precast Base:
  - 1. PennDOT No. 2A coarse aggregate, Table C, Section 703.2, Publication 408 Specifications.

2.4 BACKFILL MATERIAL FOR UTILITIES

- A. All Concrete and Asphalt Paving:
  - 1. PennDOT No. 2A coarse aggregate, Table C, Section 703.2, Publication 408 Specifications.
- B. Unpaved Areas:
  - 1. PennDOT No. 2A coarse aggregate, Table C, Section 703.2, Publication 408 Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Identify required lines, levels, contours and datum.

- B. Notify Architect of unexpected subsurface conditions and discontinue work in area until notified to resume work.
- C. Maintain and protect existing utilities identified by utility users within the Work area.
- D. Verify that structure walls are braced to support surcharge forces imposed by backfilling operations.

### 3.2 PROTECTION OF ADJACENT WORK

- A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
- B. Grade excavation top perimeter to prevent surface water runoff into excavation or to adjacent properties.

### 3.3 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. Coordinate the work to ensure the least inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the roadway is authorized.
- B. Maintain access to all streets and private drives.
- C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform with construction operations and to keep traffic flowing with minimum restrictions.
- D. Comply with State and local Municipal codes, permits and regulations and pay for all permits and inspections that are required for the installation.

### 3.4 CUTTING PAVED SURFACES

- A. Where installation of pipelines, structures, and appurtenances necessitate breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the edge of the excavation. Cut offsets at right angles to the edge of the excavation.
- B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.
- C. The requirement for neat line cuts, in other than state highways, may be waived if the final paving restoration indicates overlay beyond the width of the excavation.

### 3.5 EXCAVATION

- A. Depth of Excavation:
  - 1. Pipelines: Excavate trenches to the depth and grade shown on the profile drawings for the invert of the pipe plus that excavation necessary for placement of pipe bedding material.

2. Where unsuitable bearing material including shattered rock due to drilling or other operations is encountered in the bottom of the excavation, discontinue excavation until the unsuitable material is observed by the Architect or the Owner's representative.
  3. Where contractor, by error or intent, excavates beyond the minimum required depth, backfill the excavation to the required depth with pipe bedding/embedment or slab/base material as appropriate without any change in the Contract Price.
- B. Width of Excavation:
1. Pipelines: Excavate trenches, including laterals, to a width necessary for placement and jointing of the pipe, and for placing and compacting pipe embedment under, around and over the pipe. Shape trench walls completely vertical from trench bottom to at least two (2) feet above the top of the pipe. For pressure pipeline fittings, excavate trenches to a width that will permit placement of concrete thrust blocks. Provide earth surfaces for thrust blocks that are perpendicular to the direction of thrust and are free of loose or soft material.
  2. Structures: Excavate to the minimum distance necessary for placement/installation of the footings, concrete slab, walls or prefabricated structures and to permit proper backfill procedures to be performed.
- C. Length of Open Trench:
1. Do not advance trenching operations more than 200' ahead of completed pipeline.

### 3.6 SUPPORT OF EXCAVATION

- A. Support excavations with sheeting, shoring, and bracing or in the case of pipeline construction, a "trench box" as required to comply with Federal, State, and local laws and codes.
- B. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of contractor in any other manner, shall be repaired at contractor's expense.
- C. Withdraw shoring, bracing, and sheeting as backfilling proceeds unless otherwise directed by the Architect.
- D. The neglect, failure or refusal of the Architect to order the use of bracing or sheeting, or a better quality, grade, or section, or larger sizes of steel or timber, or to order sheeting, bracing, struts, or shoring to be left in place, or the giving or failure to give orders or directions as to the manner or methods of placing or driving sheetings, bracing, jacks, wales, stringers, etc., shall not in any way or to any extent relieve Contractor of any responsibility concerning the condition of excavation or of any of his obligations under the Contract, nor shall any delay, whether caused by any action or want of action on the part of Contractor, or by any act of Owner and Architect or their agents, or employees, resulting in the keeping of an excavation open longer than would otherwise have been necessary, relieve contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of their obligations under the

Contract relating to injury of persons or property, nor entitle them to any claim for extra compensation.

**3.7 CONTROL OF EXCAVATED MATERIAL**

- A. Keep the ground surface, within a minimum of 2' of the sides of the excavation free of excavated material.
- B. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.
- C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes, fire and police call boxes, and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural water courses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of the work.
- D. In areas where excavations parallel or cross streams, ensure that no material slides, is washed, or dumped into the stream course.

**3.8 DEWATERING**

- A. Keep excavations dry and free of water. Dispose of precipitation and subsurface water clear of the work.
- B. Maintain pipe trenches dry until pipe has been jointed, inspected, and backfilled, and concrete work has been completed. Prevent trench water from entering pipelines under construction.
- C. Intercept and divert surface drainage away from excavations. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water.
- D. Comply with Federal and State requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

**3.9 PIPE LAYING**

- A. Provide required pipe bedding placed in accordance with the Drawings and Specifications. A minimum bedding of 6" shall be provided.
- B. Shape recesses for the joints or bell of the pipe by hand. Assure that the pipe is supported on the lower quadrant for the entire length of the barrel.
- C. Lay pipe as specified in the appropriate Section of these Specifications for pipeline construction.

**3.10 BACKFILLING EXCAVATIONS**

- A. Pipeline Trench:

1. After pipe installation and inspection, provide material to complete the pipe embedment in accordance with the Drawings and Specifications.
2. Unless otherwise shown on the Drawings, the following bedding or embedment requirements using the material indicated:
  - a. Storm Sewers: Pipe embedment to 12" above the crown of the pipe.
  - b. Potable Water: Pipe embedment to one-half ( $\frac{1}{2}$ ) the outside diameter of the pipe.
3. The material shall be hand placed and carefully compacted with hand-operated mechanical tampers in layers of suitable thickness to provide specified compaction around and under the haunches of the pipe. Backfill and compact the remainder of the trench with specified backfill material in accordance with the Drawings and any relevant permit conditions. Employ a placement method so not to disturb or damage the utility line in the trench. Use of a Hydra-hammer or jumping-jack type compaction device is not permitted. A vibratory plate type compaction device is acceptable. Any settlement which occurs because of consolidation of the backfill during the construction period or during the one (1) year maintenance period shall be completely corrected by contractor at his expense.
4. Provide warning tape approximately 12" below finished grades and above all piping.

**B. Lift Thickness Limitations:**

1. Lift thicknesses shall be limited to four (4) inches for pipe embedment, eight (8) inches maximum for pipeline trenches within paved areas and twelve (12) inches maximum for pipeline trenches in non-paved areas and for structure excavations. Lift thicknesses shall also comply with requirements imposed by any State Highway Occupancy Permit. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations for the compaction equipment to be utilized. Compaction equipment shall not be used over the pipe until sufficient backfill has been placed to ensure that such equipment will not damage or disturb the pipe.
2. Lift thickness limitations specified for State highways, shoulders, or embankments govern over the compaction equipment manufacturer's recommendations.

**C. Unsuitable Backfill Material:**

1. Where the Architect determines backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with suitable backfill material. Unsuitable material shall be legally disposed of, off-site by the contractor.

**3.11 FIELD QUALITY CONTROL**

- A. Quality Control Testing During Construction:** Contractor shall obtain and pay for a testing laboratory to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.
  - a. Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.
  - b. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
2. Perform one test at each structure and one test for each 150 lineal feet of pipe or fractions thereof per foot of backfill.
3. If in opinion of Architect, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

#### 3.12 DISPOSAL OF EXCAVATED MATERIAL

- A. Excavated material remaining after completion of backfilling shall remain the property of contractor, removed from the construction area, and disposed of legally, off-site. However, in the event the excavated material can be used in filling and rough grading on the site as determined by the Architect, it shall remain on the site and be used for grading and filling.

END OF SECTION 220510

**SECTION 220530 - METERS AND GAUGES FOR PLUMBING SYSTEMS**

**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 Thermometers, Gauges and Test plugs.

**PART 2 - PRODUCTS**

**2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, provide fully adjustable angle thermometers by one of the following:
  - 1. Palmer - Wahl Instruments Inc.
  - 2. Trerice, H. O. Co.
  - 3. Weiss Instruments, Inc.
  - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
  - 5. Miljoco Corporation.
- B. Case: Cast aluminum with dark blue epoxy coating, 9 inches long.
- C. Window: Clear acrylic for temperatures up to 300 deg. F; glass for higher temperatures.
- D. Tube: blue reading, organic filled.
- E. Stem: brass for thermowell installation and of length to suit installation.
- F. Accuracy: Plus or minus 1 scale division.

**2.2 THERMOWELLS**

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, brass construction, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

**2.3 PRESSURE GAUGES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
5. Miljoco Corporation.

B. Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, fiberglass reinforced polypropylene, 4-1/2-inch diameter, solid front, blow out back.
2. Pressure-Element Assembly: Bronze Bourdon tube.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet.
4. Movement: Stainless steel rotary type with stainless steel bushings.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Acrylic plastic.
8. Accuracy: Plus or minus .5 percent range.
9. Vacuum-Pressure Range: 30-in. Hg of vacuum to 150 psig of pressure.
10. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gauge Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type valve.

## 2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements provide test plug (PT Plug) products by one of the following:

1. Flow Design, Inc.
2. Peterson Equipment Co., Inc.
3. Sisco Manufacturing Co.
4. Trerice, H. O. Co.
5. Watts Industries, Inc.; Water Products Div.

B. Description: Ports are to be suitable to accept thermometer stem or pressure gauge adapter and shall have dual EPDM internal seals, threaded brass cap with metal retainer strap. Ports are to be adequate length and suitable for installation in insulated or non insulated piping.

C. Construction: Brass body with dual EPDM seals.

D. Minimum Pressure and Temperature Rating: 1000 psig at 270 deg F.

E. Test Kit: Furnish one test kit containing one pressure gauge and adaptor, two thermometers, and carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

## PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install thermometers where indicated on the drawings, see plans and detail drawings.
- B. Provide the following temperature ranges for thermometers:
  - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
  - 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

- A. Install pressure gauges at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- D. Install shut-off needle-valve and snubber fitting in piping for each pressure gauge and thermometer.
- E. Install test plugs in tees in piping.
- F. Install connection fittings for attachment to portable indicators in accessible locations.
- G. Adjust faces of thermometers and gauges to proper angle for best visibility.

END OF SECTION 220530



**SECTION 220540 – GENERAL DUTY VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Ball valves.
  - 2. Butterfly valves.
  - 3. Check valves.

**1.3 SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- D. The installation and materials shall comply with the requirements of the 2015 International Plumbing Code and any applicable local code amendments. Verify code with requirements with the local code officials.

**PART 2 - PRODUCTS**

**2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- B. Valve Sizes: Same as upstream piping unless otherwise indicated.

- C. Valves in Insulated Piping: With 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.
- D. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
  - 3. Threaded: With threads according to ASME B1.20.1.
- E. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRASS BALL VALVES

- A. Two-piece full-port, Brass Ball Valves with Brass Trim:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. Stockham.
    - e. Jomar Valve.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig (1035 kPa).
    - c. CWP Rating: 600 psig (4140 kPa).
    - d. Body Design: Two piece.
    - e. Body Material: Forged brass.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Brass.
    - i. Ball: Chrome-plated brass.

## 2.3 BRONZE BALL VALVES

- A. Full-Port, Bronze Ball Valves with Bronze 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 (1035 kPa).
  - c. CWP Rating: 600 psig (4140 kPa).
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.

#### 2.4 BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron 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; Stockham Division.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    - e. Seat: EPDM.
    - f. Stem: One- or two-piece stainless steel.
    - g. Disc: Nickel-plated or -coated ductile iron.
- B. Grooved Copper Butterfly: DN65-DN150, 300 psi max pressure rating with copper tubing sized grooved ends. Cast bronze body to CDA-836 (85-5-5-5). Elastomer encapsulated ductile iron disc, ASTM A-536, Grade 65-45-12, with integrally cast stem.

#### 2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group
    - b. Milwaukee Valve Company.

- c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - e. Jomar Valve.
2. Description:
- a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig (1380 kPa).
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

### 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.

#### 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 or butterfly valves.
2. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided check valves.

END OF SECTION 220540





**SECTION 220570 - IDENTIFICATION FOR PLUMBING SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipe labels/markers.
  - 2. Stencils.
  - 3. Valve tags and schedules.

**1.3 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 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 partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## 2.2 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Fiberboard or metal.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: Brass, 0.032-inch (0.8-mm) or Stainless steel, 0.025-inch.
  - 2. Fasteners: Brass wire-link or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## 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 and paints.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of plumbing equipment such as pumps, water heaters and water softeners. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule (not all systems may be applicable to this project):
1. Domestic Water Piping, including cold water, various hot water systems and various hot water return systems):
    - a. Background Color: Black or Blue.
    - b. Letter Color: White.
  2. Sanitary and Acid Waste and Storm Drainage Piping:
    - a. Background Color: Black or Blue.
    - b. Letter Color: White.
  3. Natural Gas Piping: refer to specification section 221620 for requirements.:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
    - c. Mark: Natural Gas.
  4. Compressed Air Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
    - c. Mark: Compressed Air.

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. Provide a valve schedule in all equipment rooms.
- 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 and Hot Water: 1-1/2 inches round or square.
- 2. Valve-Tag Color:
  - a. Natural.
- C. The location of all valves shall be indicated by locator tags on the ceiling tile. Provide equipment locator tags in a color suitable to the owner. Tags to be push tack type with 7/8" diameter head as manufactured by Marketing Services Inc. or equal.

END OF SECTION 220570

**SECTION 220700 - PLUMBING SYSTEM INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This section includes insulation materials and accessories for insulating Plumbing piping and equipment.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity and jackets (both factory- and field-applied, if any).

**1.4 QUALITY ASSURANCE**

- A. 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 rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

**1.6 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with piping Installer for insulation application.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Mineral-Fiber Plumbing Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Products: Subject to compliance with requirements, provide Johns Manville Micro-Loc insulation or equal products manufactured by one of the following:
    - a. Knauf Insulation.
    - b. Owens Corning Fiberglas 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-SSL.
  3. Provide High-impact-resistant, UV-resistant PVC jacketed fitting covers complying with ASTM D 1784, Class 16354-C; Flame spread 25 or less; Smoke development 50 or less.
- B. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- C. Flexible Elastomeric Thermal Insulation: 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 products manufactured by one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 CEMENTS, ADHESIVES AND MASTICS

- A. Provide all required types of cements, adhesives, mastics and other accessories required to install all insulation materials and systems per the Manufacturer's Installation Requirements. Prepare surfaces as required by the insulation manufacturers. Install cements, adhesives and mastics per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply 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. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.



- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply 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 4 inches (100 mm) o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Firestopping and fire-resistive joint sealers are specified in other Division 22 Sections.
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

### 3.2 MINERAL-FIBER INSULATION APPLICATION

- A. Insulation Installation on Straight Pipes and Tubes per manufacturer's instructions. Where vapor barriers are required, seal longitudinal seams, end joints, and protrusions with vapor-barrier

mastic and joint sealant. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c. 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, Elbows, 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.

**3.3 FLEXIBLE ELASTOMERIC INSULATION APPLICATION**

- 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. Apply Insulation on Pipe Fittings, Elbows, Valves and Pipe Specialties.

**3.4 INSULATION APPLICATION SCHEDULE, GENERAL**

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

**3.5 INTERIOR INSULATION APPLICATION SCHEDULE**

- A. Service: Domestic hot and re-circulated hot water.

1. Operating Temperature: 60 to 140 deg F.
2. Insulation Material: 1 ½" Mineral fiber.

- B. Service: Domestic cold water.

1. Operating Temperature: 35 to 60 deg F.
2. Insulation Material: 1" thick Mineral fiber with vapor barrier.

- C. Service: Rainwater conductors and roof drain bodies.

1. Insulation Material: 1" Mineral fiber with vapor barrier.

- D. Service: Condensate drain piping.

1. Insulation Material: ¾" Flexible elastomeric.

- E. Service: Sanitary drain piping and accessories, associated with condensate drains, where indicated on the drawings.

1. Insulation Material:  $\frac{3}{4}$ " Flexible elastomeric.

END OF SECTION 220700

**SECTION 221105 - FACILITY WATER DISTRIBUTION PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

This Section includes water-distribution piping and related components outside the building perimeter for domestic water service and fire-service mains.

**1.3 DEFINITIONS**

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
  - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
  - 1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

#### 1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  1. Notify Architect no fewer than ten days in advance of proposed interruption of service.
  2. Do not proceed with interruption of water-distribution service without Architect's written permission.

#### 1.10 COORDINATION

- A. Coordinate connection to water main with utility company. The Utility Provider shall determine exact service tapping location in the field.

### PART 2 - PRODUCTS

#### 2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Provide "double" cement lining in accordance with ANSI A21.4 (AWWA C104).
  2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
  1. Grooved-End, Ductile-Iron Pipe Appurtenances:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil International, Inc.
    - 2) Victaulic Company of America.
  - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
  - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- C. Flanges: ASME 16.1, Class 125, cast iron.

## 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) and ASTM B88, Type L (ASTM B88M, Type B).
- B. Annealed-Temper Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) and ASTM B88, Type L (ASTM B88M, Type B).
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Copper Tube, Pressure-Seal-Joint Fittings:
  - 1. Source Limitations: Obtain copper tube, pressure-seal-joint fittings from single manufacturer.
  - 2. Standard: UL 213.
  - 3. Fittings: Cast brass, cast bronze, or wrought copper with EPDM O-ring seal in each end. NPS 2-1/2 (DN 65) and larger with stainless steel grip ring and EPDM O-ring seal.
  - 4. Minimum 200 psig (1379 kPa) working-pressure rating at 250 deg F (121 deg C).
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- G. Cast-Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock-body, ball-and-socket, metal-to-metal seating surfaces; and solder-joint or threaded ends.
- H. Wrought-Copper Unions: ASME B16.22.

## 2.3 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. EBAA Iron, Inc..

2. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

C. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cascade Waterworks Manufacturing.
  - b. Dresser, Inc.; Dresser Piping Specialties.
  - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
  - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
  - e. JCM Industries.
  - f. Smith-Blair, Inc.
  - g. Viking Johnson.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.



- a. Standard: AWWA C219.
  - b. Center-Sleeve Material: Manufacturer's standard.
  - c. Gasket Material: Natural or synthetic rubber.
  - d. Pressure Rating: 150 psig (1035 kPa)
  - e. Metal Component Finish: Corrosion-resistant coating or material.
- C. Split-Sleeve Pipe Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Victaulic Depend-O-Lok.
  2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
    - a. Standard: AWWA C219.
    - b. Sleeve Material: Manufacturer's standard.
    - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
    - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
    - e. Pressure Rating: 200 psig minimum.
    - f. Metal Component Finish: Corrosion-resistant coating or material.
- D. Flexible Connectors:
1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
  2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.
- E. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  2. Dielectric Unions:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating: 150 psig 1035 kPa.
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  3. Dielectric Flanges:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Factory-fabricated, bolted, companion-flange assembly.
      - 3) Pressure Rating: 150 psig 1035 kPa.
      - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
  - a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig 1035 kPa.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
  
5. Dielectric Nipples:
  - a. Description:
    - 1) Standard: IAPMO PS 66
    - 2) Electroplated steel nipple. complying with ASTM F 1545.
    - 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

## 2.5 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Encasement for Underground Metal Piping:
  1. Standards: ASTM A 674 or AWWA C105.
  2. Form: Sheet or tube
  3. Material: LLDPE film of 0.008-inch (0.20-mm) minimum thickness, or high-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
  4. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
  5. Color: Black.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching and backfilling.

### 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.

- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 to be the following:
  - 1. Soft copper tube, ASTM B88, Type K (ASTM B88M, Type A) or ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and brazed or copper, pressure-seal fittings; and pressure-sealed joints.
- F. Underground water-service piping NPS 4 to NPS 8 shall be the following:
  - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical; ductile-iron-pipe appurtenances; joints.
- G. Aboveground and vault water-service piping NPS 4 to NPS 8 shall be the following:
  - 1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- H. Underground Fire-Service-Main Piping NPS 6 to NPS 8 shall be the following:
  - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- I. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 12 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

### 3.3 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire-service-main piping materials and installation.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
  - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- C. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:
  - 1. Under Driveways: With at least 36 inches cover over top.
  - 2. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.
- D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
  - F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
  - G. See Section "Section 211313 "Wet-Pipe Sprinkler Systems," for fire-suppression-water piping inside the building.
  - H. See Section 221110 "Domestic Water Piping" for potable-water piping inside the building.
- 3.4 JOINT CONSTRUCTION
- A. Make pipe joints according to the following:
    1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
    2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
    3. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
      - a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples and/or unions.
      - b. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
      - c. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.
- 3.5 ANCHORAGE INSTALLATION
- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
    1. Concrete thrust blocks.
    2. Locking mechanical joints.
    3. Set-screw mechanical retainer glands.
    4. Bolted flanged joints.
    5. Heat-fused joints.
    6. Pipe clamps and tie rods.
  - B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
    1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
    2. Fire-Service-Main Piping: According to NFPA 24.
  - C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

**3.6 FIELD QUALITY CONTROL**

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

**3.7 IDENTIFICATION**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

**3.8 CLEANING**

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221105

**SECTION 221110 - DOMESTIC WATER PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This section includes domestic water piping for underground, under slab and above ground installations including accessories.

**1.3 SUBMITTALS**

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Piping materials.

**1.4 QUALITY ASSURANCE**

- A. The installation shall comply with the requirements of the 2015 International Plumbing Code (I.P.C.) and any applicable local code amendments. Verify the code with requirements with the local code official(s) before beginning the work.
- B. All domestic water system components require third party certification as indicated in Chapter 3; Table 303.4 of the IPC.
- C. All domestic water piping and fittings are required to bear the identification of the manufacturer as required in Chapter 3; paragraph 303.1 of the IPC.
- D. Comply with NSF 61 for potable domestic water piping and components.

**1.5 PROJECT CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt service to any portion of the existing occupied facilities until receiving permission. If interruption of the existing service is required, coordinate the work with the Owner and, if necessary, perform the work at a time, other than normal working hours, which is suitable to the owner.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
  - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- C. Grooved Joint Copper Piping Systems: Provide grooved copper products manufactured by Victaulic. All grooved copper system components are to be supplied by the same manufacturer.
  - 1. Copper Tube: ASTM B 88, Type L roll grooved in accordance with the manufacturer's standards and copper tube dimensions.
  - 2. Couplings for grooved piping to consist of ductile iron cast housings with synthetic rubber gasket of a pressure responsive design with plated nuts and bolts to secure the unit. Couplings shall be manufactured to connect to copper tubing and fittings without flaring.
    - a. Coupling housings: ductile iron (ASTM A-536, grade 65-45-12) coated with copper colored alkyd enamel.
    - b. Coupling Gaskets: gasket to be Grade EHP EPDM compound with red color code design for operating temperatures from minus 30 degrees F to plus 250 degrees F.
    - c. Victaulic Style 607 installation ready coupling for direct stab installation with filed disassembly.
  - 3. Fittings: manufactured to copper tube sizes with grooves designed to accept grooved couplings. Fittings shall be wrought copper conforming to ASTM B-75 alloy C12200 or ASTM B-152 alloy C11000 and ANSI B16.22.
- D. Press-Fit Joint Copper Piping Systems: Provide Press-fit copper pipe products manufactured by Viega, Elkhart Products or NIBCO, Inc
  - 1. Hard Copper Tube: ASTM B88.
  - 2. Copper fittings: ASME B16.18, ASME B16.22 or ASME B16.26.
  - 3. Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an

alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect™) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

### 2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
  - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

### 2.4 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

### 2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hyspan Precision Products, Inc.
  - 2. Metraflex, Inc.
  - 3. Universal Metal Hose; a Hyspan company.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
  - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

## PART 3 - EXECUTION

### 3.1 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- D. Install shutoff valve, drain valve, pressure gage, inside the building at each domestic water service entrance.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. When required, rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas. Install exposed piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance. Install piping to permit valve servicing.
- I. 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.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- 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."

- D. Joint Construction for Grooved-End Copper Tubing: Make joints according to the manufacturer's instructions and AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE INSTALLATION

- A. 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 valves for piping NPS 3 and smaller. Use butterfly valves for piping NPS 3 and larger.
- B. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- C. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow.

### 3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

### 3.5 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.

### 3.6 WATER METER INSTALLATION

- A. Where required, rough-in domestic water piping for water meter installation, and install water meters according to utility company's requirements. Install water meters according to AWWA M6, utility company's requirements.

**3.7 PIPE HANGER AND SUPPORT INSTALLATION**

- A. Support all domestic water piping in accordance with the 2015 International Plumbing Code or local code requirements.
- B. Hangers shall be of materials that will not support galvanic action. Support piping with adjustable clevis hangers for all horizontal piping. Provide a 12" long 18 gage protective saddle for all clevis hangers that support insulated piping. Support each system independently of other piping systems, allowing for expansion of the pipe.
- C. Install hangers for copper tubing with the following spacing:
  - 1. NPS 1-1/4" and smaller: 6 feet maximum horizontal.
  - 2. NPS 1-1/2" and larger: 10 feet maximum horizontal.
  - 3. Install supports for vertical pipe at a maximum spacing of 10 feet.

**3.8 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to equipment and machines to allow service and maintenance.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  - 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

**3.9 ESCUTCHEON INSTALLATION**

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

**3.10 SLEEVE INSTALLATION**

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls. Sleeves are not required for core-drilled holes.
- B. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated. Install sleeves in new partitions, slabs, and walls as they are built.
- C. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Provide fireproofing where required.

- D. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using wall penetration systems.
- E. Install sleeve materials according to the following applications:
  - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
  - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe. Extend sleeves 2 inches above finished floor level.
  - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations.

### 3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements indicated in Specification Section 220570.

### 3.12 FIELD QUALITY CONTROL

- A. Test systems according to procedures of authorities having jurisdiction or, in absence of such procedures, testing shall be per the requirements on the International Plumbing Code Section 312, Test and Inspections.
- B. Piping Inspections: coordinate all inspection requirements with the Authorities Having Jurisdiction. Do not enclose, cover, or put piping into operation until it has been inspected and approved.
- C. Domestic water piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.13 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.

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

**3.14 DISINFECTION OF POTABLE WATER SYSTEM(S)**

- A. All domestic water piping shall be purged and disinfected prior to utilization. The method to be followed shall be that required by the 2015 International Plumbing Code, Section 610, or the requirements of the local authorities.
- B. Prepare and submit reports of purging and disinfecting activities.

**3.15 PIPING SCHEDULE**

- A. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B)]; wrought-copper solder-joint fittings; and brazed or copper pressure-seal fittings and joints.
- B. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) shall be the following:
  1. Mechanical-joint, ductile-iron pipe; mechanical-joint fittings; and mechanical restrained joints.
- C. Aboveground domestic water piping, shall be the following:
  1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) copper solder-joint fittings; and soldered, press-fit or grooved joints.

**3.16 VALVE SCHEDULE**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  2. Throttling Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221110

**SECTION 221120 - DOMESTIC WATER PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes various types of domestic water piping specialties.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. The installation and manufacture of all products shall conform to the requirements of the following:
  - 1. 2009 International Plumbing Code and any local code amendments. Verify the code requirements with the local code official(s) before beginning the work.
  - 2. Lead Free Law as adapted effective January, 2014.

**PART 2 - PRODUCTS**

**2.1 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1001.
  - 3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.

4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze where concealed, Chrome plated where exposed.

**B. Hose-Connection Vacuum Breakers:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Watts Industries, Inc.; Water Products Div.
  - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze where concealed, Chrome plated where exposed.

**2.2 BACKFLOW PREVENTERS**

**A. Reduced-Pressure-Principle Backflow Preventers: Drawing Tag "RPB"**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. Watts Industries, Inc.; Water Products Div.
  - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
5. Temperature range: 210 degrees F.
6. Size: as indicated on the drawings.
7. Pressure Loss and Design Flow Rate: as indicated on the drawings.
8. Body: Bronze for NPS 2 (DN 50) and smaller; epoxy coated cast iron complying with AWWA C550 and FDA approved for NPS 2-1/2 (DN 65) and larger.
9. Accessories: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger. Provide strainers on the inlet. Provide Air-Gap Fitting, ASME A112.1.2, matching backflow-preventer connection.

**B. Backflow Preventers: Drawing Tag "BP"**

1. Provide a Series 9D Dual Check Backflow Preventer manufactured by Watts Industries or equal as manufactured by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.

- c. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1012.
- 3. Temperature range: 33° F to 250° F.
- 4. Size: as indicated on the drawings.
- 5. Working Pressure: 25 to 175 psi.
- 6. Body: forged brass.

### 2.3 DOMESTIC SERVICE WATER METERS

- A. Water meters will be provided by the Plumbing Contractor.
- B. Manufacturers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Master Meter, Inc.
- C. Octave Double Beam Ultrasonic:
  - 1. Description: Ultrasonic type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
    - a. Standard: AWWA C7750-03.
    - b. Registration: Flow in gallons.
    - c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
    - d. Visible Display Units: Comply with utility company requirements for type and quantity.

### 2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bell & Gossett Model CS Plus
    - b. Armstrong Pump Model CVB
    - c. Flow Design Inc. Model UA
    - d. Flo Pac Model MB/MBF/MBG
    - e. Jomar Valve
  - 2. Valves: venturi type bronze body, chrome plated ball, EPDM seals. Provide pressure & temperature test ports across valve measurement area. Ports to be fitted with dual durometer EPDM cores, brass cap & O-ring seal. Valves to have drain/purge port. Provide valve with memory stop, memory lock and calibrated position indicator. Valves to be rated at 200 PSIG at 2500 F and be 100% positive shut-off. Accuracy to be +/- 3%.



2.5 FIXTURE MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Lawler Manufacturing Company, Inc.
  - d. Leonard Valve Company.
  - e. Powers; a Watts Industries Co.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Plumbing Products Group; Wilkins Div.
  - h. Acorn Controls.
2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.

2.6 DIGITAL WATER MIXING VALVE ASSEMBLIES

A. Manufacturer: Subject to compliance with requirements, provide a water mixing assembly manufactured by Powers/Watts. Products meeting the requirements and manufactured by the following will be considered:

1. Leonard Valve Company.
2. Armstrong International.

B. Description: Factory assembled and tested, Lead Free digital water temperature control and monitoring water-mixing-valve assembly with duty as indicated on the drawings. Digital Mixing Valves to comply with ASSE 1017. Include integral check stops on hot- and cold-water inlets.

C. Controller: 3.5" full color touchscreen interface configurable on location to control water temperature to +/- 2 deg F and resist "temperature creep" during no or low demand. Controller shall be password protected and adjustable outlet range of 60-180 deg F with high and low alerts. Controller shall digitally control and monitor mixed outlet temperature and shall integrate with building automation systems through BACnet and Modbus protocols and feature local and remote temperature alarms. System shall feature a user set, high -temperature sanitation mode for thermal disinfection and programmable temperature set back feature. System shall fail full cold open and in event loss of cold water, system shall close hot water supply.

1. Power: 120-1-60.
2. Mixing Valve Finish: rough bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 and larger.
3. Screen: Stainless steel with round perforations, unless otherwise indicated.
4. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.033 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c. Strainers NPS 5 and Larger: 0.125 inch.
5. Drain: Factory-installed, hose-end drain valve.

## 2.8 OUTLET BOXES

### A. Clothes Washer Outlet Boxes WOB1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Guy Gray Manufacturing Co., Inc. or equal.
2. Material and Finish: Epoxy-painted-steel or enameled-steel box and faceplate.
3. Mounting: Recessed. Provide fire-rated construction where installed within fire-rated walls.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Accessory: Water hammer arresters.

### B. Icemaker Outlet Boxes IMB1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Guy Gray Manufacturing Co., Inc. or equal.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## 2.9 HOSE BIBBS

### A. Hose Bibbs HB:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.

4. Pressure Rating: 125 psig.
5. Vacuum Breaker: Integral.
6. Finish for Equipment Rooms: Rough bronze.
7. Finish for Service Areas: Chrome plated.
8. Finish for Finished Rooms: Chrome plated.
9. Operation: operating key.
10. Include operating key with each operating-key hose bibb.
11. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Non-freeze Wall Hydrants WH-1:

1. Manufacturers: Zurn Model Z1320-C or equal.
2. Provide anti-siphon, automatic draining non-freeze wall hydrant with integral backflow preventer.
3. Operation: Loose key.
4. Provide length required to match wall thickness.
5. Nozzle and Wall-Plate Finish: Chrome plated cast bronze.
6. Operating Keys(s): Two with each wall hydrant.

### B. Interior Hot & Cold Water Wall Hydrants WH-2:

1. Manufacturers: Acorn model 8156 or equal.
2. Provide Acorn Recessed Hose Box model 8156 with Wall Flange.
3. Box shall be fabricated with 18 gage, type 304 stainless steel, with a satin finished exterior. Flange shall be 16 gage stainless steel and be polished to a satin finish. Door shall be 16 gage with satin finish and removable hinge and cylinder lock
4. Valve shall be cartridge-operated type with vandal-resistant lock shield, removable loose key wheel handle and screwdriver operated stops.
5. Provide hydrant with vacuum breaker.

## 2.11 ROOF HYDRANTS

### A. Non-freeze, Draining-Type Roof Hydrants RH-1:

1. Manufacturers: Woodford Manufacturing Company; a division of WCM Industries, Inc Model RHY2-MS or equal.
2. Standard: ASME A112.21.3M.
3. Type: Non-freeze, exposed-outlet roof hydrant.
4. Operation: Lever Lock with plunger.
5. Casing and Operating Rod: cast iron underdeck flange with EDPM boot cover and 35 1/2" operating rod.
6. Casing: 1 1/4".
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain to indirect waste inlet when shut off.
10. Vacuum Breaker:

- a. Non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052. Garden-hose thread complying with ASME B1.20.7 on outlet.

## 2.12 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.13 TRAP-SEAL PRIMER VALVES

### A. Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products conforming to ASSE 1018 manufactured by one of the following:
  - a. MIFAB, Inc.
  - b. Precision Plumbing Products Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Industries, Inc.; Water Products Div.
2. Body: Bronze.
3. Inlet and Outlet Connections: NPS 1/2 threaded or solder joint.
4. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 2.14 TRAP-SEAL PRIMER SYSTEMS

### A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products conforming to ASSE 1044 and manufactured by Precision Plumbing Products Inc. or equal.
2. Piping: NPS 3/4, ASTM B 88, Type L copper, water tubing.
3. Cabinet: Surface-mounting steel box with stainless-steel cover.

4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
5. Vacuum Breaker: ASSE 1001.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

##### A. BACKFLOW PREVENTERS:

1. Install Reduced-Pressure-Principal-Backflow-Preventers (noted as RPB on the drawings) in each water supply to HVAC equipment and systems, at the service entrance for the domestic water main and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
2. In addition to installing an RPB, install Backflow Preventers (noted as BP on the drawings) in each water fill connection to boilers.
3. Install drain for all backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
4. Do not install bypass piping around backflow preventers. Locate backflow preventers in same room as connected equipment or system. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet. Install thermometers and water regulators if specified. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve and pump.

E. Install outlet boxes recessed in wall.

F. Install non-freeze, nondraining-type post hydrants set in concrete or pavement.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

K. Connect drain piping from roof hydrant and route to nearest indirect waste termination. Install nonfreezing, nondraining-type roof hydrants per Manufacturer recommendations and where accessible for maintenance.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221120



**SECTION 221130 - DOMESTIC WATER PUMPS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes all bronze and bronze fitted in-line pumps used in domestic water systems.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. The installation shall comply with the requirements of the 2015 International Plumbing Code and any applicable local code amendments. Verify the code with requirements with the local code officials before beginning the work.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.



PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL PUMPS

- A. Subject to compliance with requirements, provide pumps manufactured by one of the following:
  - 1. Armstrong Pumps Inc.
  - 2. Bell & Gossett Domestic Pump; ITT Corporation.
  - 3. PACO.
  - 4. TACO Incorporated.
- B. Description: Factory-assembled and -tested, in-line, single-stage all bronze centrifugal pumps. Pumps to be suitable for operation at 225 degrees F and a working pressure of 175 psig.
- C. Pump Construction:
  - 1. Casing: all bronze.
  - 2. Impeller: cast bronze, statically and dynamically balanced, and keyed to shaft.
  - 3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
  - 4. Coupling: Flexible.
  - 5. Seal: internal flush mechanical seal, stainless-steel spring, ceramic seat, and Buna bellows and gasket.
  - 6. Bearings: permanently lubricated.
  - 7. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- D. Motor: Single speed, with permanently lubricated ball bearings; and mounted to pump casing. Motors to be non-over loading.
- E. Pump capacities and operating characteristics are noted on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Install in-line centrifugal pumps according to the manufacturer's instructions.
- B. Install continuous-thread hanger rods of size required to support pump weight.
- C. Install thermostats in hot-water return piping.
- D. Install time-delay relays in piping between water heaters and hot-water storage tanks.

**3.3 CONNECTIONS**

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the pumps.
  - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping.
  - 3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tapplings where provided or install pressure-gage connectors in suction and discharge piping around pumps.
- D. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

**3.4 IDENTIFICATION**

- A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

**3.5 STARTUP SERVICE**

- A. Perform startup service:
  - 1. Complete installation and startup check according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Set controls for automatic starting and stopping operation of pumps.
  - 5. Perform the following startup checks for each pump before starting:
    - a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - b. Verify that pump is rotating in the correct direction.
  - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 7. Start motor.
  - 8. Open discharge valve slowly.
  - 9. Adjust temperature settings on thermostats.
  - 10. Adjust timer settings.

3.6 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.

END OF SECTION 221130

**SECTION 221311 - SANITARY WASTE AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes soil, waste, and vent piping inside the building.

**1.3 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.

**1.4 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. The installation shall comply with the requirements of the 2015 International Plumbing Code (I.P.C.) and any applicable local code amendments. Verify the code with requirements with the local code officials before beginning the work.
- C. All sanitary piping and fittings are required to bear the identification of the manufacturer as required in Chapter 3; 303.1 of the IPC. PVC pipe and fittings shall be third party certified per the requirements of the I.P.C.
- D. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be Third Party Tested per the requirements of the I.P.C.

**1.5 FIELD CONDITIONS**

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than five days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Identification: Each length of pipe and each pie fitting, trap, fixture material and device utilized in a plumbing system shall bear the identification of the manufacturer.
- B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute® and listed by NSF® International. Pipe and fittings to be Service (SV) class.
- B. Provide joints using a compression gasket manufactured from an elastomer meeting the requirements of ASTM C 564 or lead and oakum.
- C. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute © and listed by NSF® International.
- B. Hubless Couplings shall conform to ASTM C 1540 for heavy duty couplings. Gaskets shall conform to ASTM C 564.
- C. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque recommendations. Tighten bands with a properly calibrated torque limiting device.

2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 1. Copper Drainage Fittings: cast copper or wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

- C. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.5 PVC PIPE AND FITTINGS

- A. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 as identified in ASTM D 1784.
- B. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. PVC DWV fittings shall conform to ASTM D 2665. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. All systems shall utilize a separate waste and vent system. Pipe and fittings shall conform to NSF International Standard 14.
- C. Adhesive Primer: ASTM F 656.
  - 1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent Cement: ASTM D 2564.
  - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
  - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
- B. Aboveground, soil and waste piping NPS 5 and larger shall be:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel rigid, couplings; and hubless-coupling joints.
- D. Aboveground, vent piping NPS 5 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

E. Underground, soil, waste, and vent piping shall be:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Refer to the contract drawings which indicate areas where the installation of PVC pipe is prohibited. Kitchen equipment discharge and mechanical room services.

### 3.2 EXCAVATION AND BACKFILL

- A. Provide all excavation and backfill required for underground piping installations. Perform excavation and backfill work conforming to the requirements of Section 306, Trenching, Excavation and Backfill, of the 2015 International Plumbing Code.

### 3.3 PIPING INSTALLATION

- A. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- D. Underground PVC piping: Installation shall comply with the latest installation instructions published by the manufacturer and shall conform to all applicable plumbing code requirements. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668. Solvent cement joints shall be made in a two step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds. Systems shall be hydrostatically tested after installation.
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants,

cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
- H. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.4 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### 3.5 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
  - 1. Install full-port ball valve for piping NPS 2 and smaller.
  - 2. Install butterfly valve for piping NPS 2-1/2 and larger.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- C. Backwater Valves: Install backwater valves where indicated.



**3.6 HANGER AND SUPPORT INSTALLATION**

- A. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. All sizes: 60 inches.
  - 2. Hangers spacing may be increased to 10'-0" when 10 foot lengths of pipe are used.
- B. Install supports for vertical cast-iron soil piping every 15 feet and at all floors.
- C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches.
  - 2. NPS 1-1/2 and larger: 120 inches.
- D. Install supports for vertical copper tubing every 10 feet and at all floors.

**3.7 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

**3.8 FIELD QUALITY CONTROL**

- A. Test systems according to procedures of authorities having jurisdiction or, in absence of such procedures, testing shall be per the requirements on the International Plumbing Code Section 312, Test and Inspections.
- B. Piping Inspections: coordinate all inspection requirements with the Authorities Having Jurisdiction. Do not enclose, cover, or put piping into operation until it has been inspected and approved.
- C. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221311



**SECTION 221320 - SANITARY WASTE PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes sanitary drainage piping specialties.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals. Provide wiring diagrams for power, signal, and control wiring, where applicable.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

**1.5 COORDINATION**

- A. Coordinate size and location of concrete bases where applicable. Coordinate size and location of roof penetrations.

**PART 2 - PRODUCTS**

**2.1 BACKWATER VALVES**

- A. Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.

## 2.2 CLEANOUTS

- A. Provide cleanouts and all required accessories manufactured by one of the following:
  1. Josam Company.
  2. Smith, Jay R. Mfg. Co.
  3. Tyler Pipe; Wade Div.
  4. Watts Drainage Products Inc.
  5. Zurn Plumbing Products Group.
- B. Brass cleanout plugs shall conform to ASTM A74, ASME A112.3.1 or ASME A112.36.2N.
- C. Cleanout locations and details are indicated on the drawings and noted in Part 3.

## 2.3 FLOOR DRAINS

- A. Provide cast-iron and/or stainless steel floor drains per the model numbers indicated on the drawings included all required accessories. Provide drains manufactured by one of the following:
  1. Josam Company; Josam Div.
  2. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  3. Tyler Pipe; Wade Div.
  4. Watts Drainage Products Inc.
  5. Zurn Plumbing Products Group.
- B. Floor drains shall conform to the requirements of Section 412 of the International Plumbing Code.
- C. Floor drains to have removable strainers and constructed so the drain can be cleaned.

## 2.4 DRAINAGE PIPING SPECIALTIES

- A. Deep-Seal Traps:
  1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.
    - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
    - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Barrier-Type Trap Seal Devices:

1. Description: Elastomeric, normally closed seal to prevent evaporation and protect against sewer gases from entering habitable spaces. Inlet and outlet shall match connected piping and assembly shall conform to ASSE 1072.

D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counter flashing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backwater valves in building drain piping were indicated on the drawings. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts in piping located below floors, install cleanout deck plates with top flush with finished floor.

- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install stack air-admittance valves at top of stack vent and vent stack piping.
- H. Install air-admittance-valve wall boxes recessed in wall.
- I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- K. Install through-penetration firestop assemblies at floor penetrations.
- L. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- M. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- P. Install vent caps on each vent pipe passing through roof.
- Q. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- R. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- S. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

- T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- U. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to equipment to allow service and maintenance.

### 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221320





**SECTION 221350 – SEWAGE LIFT SYSTEM**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes Sewage Lift System and Accessories.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

**1.5 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**PART 2 - PRODUCTS**

**2.1 SEWAGE LIFT STATION**

Provide pre-packaged sewage lift system model PSLS-35-20-GRP12-3696DX as manufactured by Penn Pump and Company, Inc., Hatfield, PA.

- A. The prepackaged pump station components shall be pre-assembled and tested prior to shipment. The pre-assembled package shall include two (2) submersible grinder sewage pumps

each rated at 35 GPM at 20 feet of head, 1.5 HP, 3450 rpm, 460-3-60 with a discharge of 2" inches. Each pump shall include a basin flush system to flush the wet well and mix the solids. The pump impeller shall be cast iron, balanced semi-open design capable of passing 2.5" inch solids. The pumps shall be mounted with a slide rail removal system including stainless steel guide rails and 304 stainless steel lifting chain. The pump station piping shall be schedule 80 PVC (size 2") and include a cast iron gate valve and ball check valve for each pump.

- B. **Fiberglass Basin:** The Fiberglass basin wet well and integral valve box shall be constructed of fiberglass reinforced polyester. The resins used shall commercially grade polyester and shall be evaluated as a laminate by test or determined by a previous service to be acceptable for the intended environment. The reinforcing material shall reinforcing be a commercial grade of glass fiber having a coupling agent, which will provide a bond between the glass reinforcement material and resin. FRP laminate must be designed to withstand wall collapse or buckling on the following; hydrostatic pressure of 62.4 lbs. per square foot, saturated soil weight of 120 lbs. per cubic foot, soil modulus of 700 lbs. per square foot, the wet well FRP laminate must be constructed to withstand or exceed two times the assumed loading on any depth of the wet well. The wet well FRP bottom shall have less than 0.375 inches of center elastic deflection when in service in totally submerged conditions. The wet well top flange shall have an outside diameter of at least 4 inches greater than the inside diameter of the well. A six-hole pattern shall accommodate mounting of the cover with at least 0.375 inches in a diameter 300 series stainless steel fasteners. Noncorroding stainless steel threaded inserts shall be fully encapsulated with non-continuous mat or chopped-strand fiber reinforcement. Th inserts shall have an off-set tab to prevent stripping or spinning out when removing or reinserting cover fasteners. The fiberglass basin shall be the size shown on the drawings and shall have a solid fiberglass cover as required.
- C. **Pump Controls:** Furnish a NEMA 4X duplex Penn Pump alternating control panel for remote mounting to contain, components to be NEMA rated.
1. ATL Magnetic motor starters.
  2. Circuit breakers
  3. Control transformer
  4. HOA selector switches
  5. Pump pilot lights
  6. Electronic alternator
  7. Optional separate 115v alarm power.
  8. High level alarm light and horn
  9. Alarm silence and test button
  10. Remote alarm contacts for connection to Building Energy Management System
  11. Float switches with stainless steel mounting clamps.
  12. Seal leak and motor thermal sensors.
- D. The pumping system manufacturer/ supplier shall provide all of the system components to insure proper pump station performance.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The plumbing contractor is responsible for proper installation of the pumps and accessories and installation per the manufacturer's instructions.
- B. The Electrical Contractor will provide all power and all control wiring to and from the pump station. The Plumbing Contractor shall wire from pumps in basin to control station.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. EXCAVATING. The excavation should provide adequate space for the basin, piping and other buried equipment and for the placement and compaction of backfill materials particularly around the basin walls. The size, shape and wall slope of the excavation should be determined by soil conditions, depth of excavation, shoring requirements, and, if workers are required to enter the excavation, safety considerations and federal, state, county and municipal regulations. Locate all overhead and underground utilities before excavating.
  - 1. Excavation for an underground basin should be made with due care to avoid undermining foundations of existing structures and contact with underground utilities. In the absence of building codes or regulations, maintain a minimum distance of five feet plus a slope of 45° from the bottom of the compacted sub-base to the bottom of the adjacent structures, foundations, footings and property lines. Additional distances may be required to assure that any loading carried or created by the foundations and support cannot be transferred to the basins.
  - 2. Safe installation procedures shall be the sole responsibility of the basin installer. Work safety requirements are defined in U.S. Department of Labor 29 CFR part 1926, subpart P, Excavations.
  - 3. Careful selection, placement and compaction of approved backfill material are critical to a successful basin installation. Among common problems associated with basin leaks and premature failures are:
    - a. Use of an incorrect backfill material.
    - b. Inadequate or improper placement or compaction.
    - c. Rocks, clods or debris left in the excavation or basin.
    - d. Voids under or around the perimeter of the basin.
    - e. Failure to prevent the migration of backfill materials.
- D. Placement of Basin. The bottom of the basin excavation should be covered with suitably graded, leveled and compacted backfill material to a depth of at least 12 inches (compacted sub-base). Provide reinforced concrete hold-down/anti-floatation pad. The basin shall then be carefully lowered into the excavation and centered on the concrete pad. Anchor basin to pad.

- E. Backfill Material. Backfill material should be clean, well granulated, free flowing, non-corrosive and inert. It should be free of ice, snow, debris, rock, or organic material, all of which could damage the tank and interfere with the compaction of the backfill material. The largest particles should not be larger than  $\frac{3}{4}$  inch. Not more than 3 percent (by weight) should pass through a #8 sieve, and the backfill material should conform to ASTM C-33, Paragraph 9.1 requirements. Approved backfill materials include:
1. Pea Gravel, naturally rounded particles with a minimum diameter of  $\frac{1}{8}$  inch and a maximum diameter of  $\frac{3}{4}$  inch.
  2. Crushed Rock, washed and free-flowing angular particles between  $\frac{1}{8}$  inch and  $\frac{1}{2}$  inch in size.
- F. Placement and Compaction of Backfill. Compaction of backfill materials should be adequate to ensure the support of the tank and to prevent movement or settlement. Backfill materials should be placed in 12-inch lifts and compacted to a minimum soil modulus of 700 pounds per square foot (psf).

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The pump manufacturer shall provide one day of field start up service and one day of owner instruction with copies

END OF SECTION 221350

**SECTION 221411 - STORM DRAINAGE PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes storm drainage piping and accessories located inside the building.

**1.3 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.

**1.4 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. The installation shall comply with the requirements of the 2009 International Plumbing Code (I.P.C.) and any applicable local code amendments. Verify the code with requirements with the local code officials before beginning the work.
- C. All sanitary piping and fittings are required to bear the identification of the manufacturer as required in Chapter 3; 303.1 of the IPC. PVC pipe and fittings shall be third party certified per the requirements of the I.P.C.
- D. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be Third Party Tested per the requirements of the I.P.C.

**PART 2 - PRODUCTS**

**2.1 PIPING MATERIALS**

- A. Identification: Each length of pipe and each pie fitting, trap, fixture material and device utilized in a plumbing system shall bear the identification of the manufacturer.
- B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

**2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute® and listed by NSF® International. Pipe and fittings to be Service (SV) class.
- B. Joints can be made using a compression gasket manufactured from an elastomer meeting the requirements of ASTM C 564 or lead and oakum.
- C. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements.

**2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.
- B. Hubless Couplings shall conform to ASTM C 1540 for heavy duty couplings. Gaskets shall conform to ASTM C 564.
- C. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque recommendations. Tighten bands with a properly calibrated torque limiting device.

**2.4 PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656: Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent Cement: ASTM D 2564: Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

**2.5 SPECIAL PIPE FITTINGS**

- A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Manufacturers:

- a. Dallas Specialty & Mfg. Co.
  - b. Fernco, Inc.
  - c. Logan Clay Products Company (The).
  - d. Mission Rubber Co.
2. Sleeve Materials:
- a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

## 2.6 ROOF DRAINS

- A. Roof Drains and Over Flow Roof Drains are provided by Others with this contract making final piping connection.

## 2.7 CLEANOUTS

- A. Provide cleanouts and all required accessories manufactured by one of the following:
  1. Josam Company.
  2. Smith, Jay R. Mfg. Co.
  3. Tyler Pipe; Wade Div.
  4. Watts Drainage Products Inc.
  5. Zurn Plumbing Products Group.
- B. Brass cleanout plugs shall conform to ASTM A74, ASME A112.3.1 or ASME A112.36.2N.
- C. Cleanout locations and details are indicated on the drawings and noted in Part 3.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
- B. Aboveground, storm drainage piping NPS 8 and larger shall be:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- C. Underground storm drainage piping shall be:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. PVC pipe and socket fittings with solvent cemented joints.



**3.2 EXCAVATION AND BACKFILL**

- A. Provide all excavation and backfill required for underground piping installations. Perform excavation and backfill work conforming to the requirements of Section 306, Trenching, Excavation and Backfill, of the 2015 International Plumbing Code.

**3.3 PIPING INSTALLATION**

- A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. Where piping is to be exposed, install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook", Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings".
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- D. Install underground PVC piping according to ASTM D 2321.
- E. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
  - 1. Minimum 1 percent downward in direction of flow.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

**3.4 JOINT CONSTRUCTION**

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

- C. PVC 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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.5 CLEANOUTS

- A. Install cleanouts in piping where indicated on the drawings and according to the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate cleanouts at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Install hangers for cast-iron soil piping with the following maximum horizontal spacing:
  - 1. All sizes: 60 inches.
  - 2. Hanger spacing for 10 foot pipe lengths, without fittings, may be increased to 10 feet.
- C. Install supports for vertical cast-iron soil piping every 15 feet and at all floors.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

- A. Test systems according to procedures of authorities having jurisdiction or, in absence of such procedures, testing shall be per the requirements on the International Plumbing Code Section 312, Test and Inspections.
- B. Piping Inspections: coordinate all inspection requirements with the Authorities Having Jurisdiction. Do not enclose, cover, or put piping into operation until it has been inspected and approved.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221411

**SECTION 221510 – GENERAL SERVICE COMPRESSED-AIR PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes piping and related specialties for general-service compressed-air systems.

**1.3 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Dielectric fittings.
  - 2. Flexible pipe connectors.
  - 3. Safety valves.
  - 4. Pressure regulators. Include rated capacities and operating characteristics.
  - 5. Automatic drain valves.
  - 6. Filters. Include rated capacities and operating characteristics.
  - 7. Lubricators. Include rated capacities and operating characteristics.
  - 8. Quick couplings.
  - 9. Hose assemblies.
- B. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

**1.4 PROJECT CONDITIONS**

- A. Where Applicable do not interrupt compressed-air service to occupied facilities. Notify the Owner's Representative, in sufficient time, in advance of proposed interruption of compressed-air service. Do not proceed with interruption of existing compressed-air service without written permission.

**PART 2 - PRODUCTS**

**2.1 PIPES, TUBES, AND FITTINGS**

- A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
  2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
  3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
  4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
  5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
  6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
  7. Grooved-End Fittings and Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Anvil International, Inc.
      - 2) Victaulic Company.
    - b. Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
    - c. Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.

**2.2 JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 FLEXIBLE PIPE CONNECTORS

- A. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

2.4 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
  - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

2.5 QUICK COUPLINGS

- A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
- C. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:
  - 1. NPS 2 and smaller: Schedule 40, black steel pipe; threaded, malleable-iron fittings; and threaded joints.
- B. Drain Piping:
  - 1. Type M copper tube; wrought-copper fittings with soldered joints.

3.2 VALVE APPLICATIONS

- A. Pipe NPS 2 and Smaller:
  - 1. Ball Valves: Three-piece, full port, brass.
  - 2. Bronze Lift Check Valves: Class 125.
  - 3. Bronze Swing Check Valves: Class 150.

**3.3 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, 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 otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Flanged joints may be used instead of specified joint for any piping or tubing system.
- I. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

**3.4 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. 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.
- D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.
- E. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to pre-lubricated gaskets.

### 3.5 VALVE INSTALLATION

- A. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- B. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- C. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

### 3.6 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

### 3.7 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment.
- D. Install automatic drain valves on after-coolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
- E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.



- F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
- G. Install quick couplings at piping terminals for hose connections.
- H. Install hose assemblies at hose connections.

### 3.8 CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

### 3.9 HANGER AND SUPPORT INSTALLATION

- A. Vertical Piping: MSS Type 8 or 42, clamps.
- B. Individual, Straight, Horizontal Piping Runs:
  - 1. MSS Type 1, adjustable, steel clevis hangers.
- C. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.
  - 4. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.
  - 5. NPS 2-1/2 (DN 65): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
  - 6. NPS 3 (DN 80): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
  - 7. NPS 3-1/2 (DN 90): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
  - 8. NPS 4 (DN 100): 17 feet (5.2 m) with 5/8-inch (16-mm) rod.
- D. Install supports for vertical, Schedule 40, steel piping every 15 feet.

### 3.10 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.11 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.

B. Tests and Inspections:

1. Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.

C. Prepare test reports.

END OF SECTION 221510



**SECTION 221520 – GENERAL SERVICE PACKAGED AIR COMPRESSORS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings 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 packaged air compressors and related accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.4 EXTRA MAINTENANCE MATERIAL

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Air-Compressor, Inlet-Air-Filter Elements: Equal to 5 percent of amount installed, but no fewer than 5 units.
  - 2. Belts: Two sets for each belt-driven compressor.

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. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Compressed-Air Service: Where applicable, do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than 5 days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's permission.

1.7 WARRANTY

- A. Manufacturer True Blue 5-year warranty.

1.8 COORDINATION

- A. When applicable, coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PACKAGED AIR COMPRESSORS

- A. Provide QGS rotary screw air compressors manufactured by Quincy Compressors. Local Representative Contact: Joe Tomel 610-420-0733.
- B. General Description: This specification covers a self-contained compressor package consisting of the compressor, a motor, V-belt drive, tank mount, tank mounted refrigerated air dryer and totally enclosed belt guard all mounted on an ASME Coded National Board approved air receiver if applicable. Suitable piping between the compressor control, dryer and receiver shall be included.
- C. Compressor(s): Oil-free, rotary-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.
  1. Coupling: Nonlubricated, flexible type.
  2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package pre-piped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
  4. Air/Coolant Receiver and Separation System: 150-psig- rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
  5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
  6. Vibration isolation.
- D. Integrated air-cooled aftercooler dryer: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F, 100-psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, upward

package discharge, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

- E. Motors: The compressor unit shall be driven by an TEFC rated high efficiency electric motor at approximately 1750 RPM, and suitable for continuous operation. The motor shall be a NEMA "T" frame, squirrel cage induction-type with an open-drip proof enclosure. The service factor on the standard motors will be 1.15 and 1.25 on standard fractional motors.
- F. Belt Guard: The compressor flywheel, motor flywheel, and v-belts shall be totally enclosed within a metal belt guard. This provides protection on all sides in accordance to OSHA specifications.
- G. Receivers: The compressor and motor shall be mounted with an ASME coded and National Board approved air receiver. The receiver shall include a safety valve, manual tank drain, and pressure gauge. A manual shut-off valve at the receiver outlet shall be included.
- H. Provide Infologic 2 Dual Control Air Regulation: Combines auto start-stop with constant speed control. The unit can operate on auto start-stop when air demand is light or on constant speed control when air demand is heavy.
- I. Starter: motor starter shall be an I.E.C. across-the-line magnetic contactor in an applicable NEMA enclosure, and equipped with properly sized thermal overload protection.
- J. Low Oil Pressure Shutdown Switch: Provide an electronic low oil pressure shutdown switch to automatically shut down the unit when oil pressure drops below a pre-set level.
- K. High Air Temperature Shutdown Switch: Provide an electronic high air temperature shutdown switch to protect the compressor against overheating.
- L. Accessories: Provide ISO 8573 compliant compressed air filter(s) and oil water separator(s) as noted on drawings.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Equipment Mounting: Install air compressors and accessories on concrete bases using with suitable vibration isolation.
- B. Arrange equipment so controls and devices are accessible for servicing.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Install the following devices on compressed-air equipment:
  - 1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
  - 2. Pressure Regulators: Install downstream from air compressors and dryers.
  - 3. Automatic Drain Valves: Install on after-coolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

3.3 IDENTIFICATION

- A. Identify general-service air compressors and components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 STARTUP SERVICE AND DEMONSTRATION

- A. Engage a factory-authorized service representative to perform the required startup service.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors and accessories.

END OF SECTION 221520

**SECTION 221620 - NATURAL-GAS PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This section includes natural gas piping, valves and accessories.

**1.3 SUBMITTALS**

- A. Product Data: For each type of the following:
  - 1. Piping materials and specialties.
  - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 3. Pressure regulators. Indicate pressure ratings and capacities.
- B. Welding certificates.
- C. Operation and Maintenance Data: For gas valves and other accessories.

**1.4 QUALITY ASSURANCE**

- A. The installation shall conform to the requirements of the 2015 International Fuel Gas Code and the requirements of the local utility company. Verify the code with requirements with the local utility before beginning the work.
- B. Refer to the International Fuel Gas Code, Section 107, for the requirements of Inspections and Testing. Coordinate requirements with the applicable code officials and the utility company representatives.
- C. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.
- C. Coordinate and schedule the main gas service installation with the local utility supplier. Prepare any permits and/or applications that may be required by the utility.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40.
  - 1. Malleable-Iron Threaded Fittings: ASME B1.20.1.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding."
  - 3. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. PE Pipe: ASTM D 2513.
  - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  - 2. PE pipe shall be marked "GAS" and "ASTM D 2513."

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.

2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Flexible Metal Connectors: Comply with ANSI Z21.75, UL 536.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm).

**B. Quick-Disconnect Devices: Comply with ANSI Z21.41.**

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

**C. Y-Pattern Strainers:**

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

**D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.**

## 2.3 JOINING MATERIALS

**A. Joint Compound and Tape: Suitable for natural gas.**

**B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.**

## 2.4 MANUAL GAS SHUTOFF VALVES

**A. Shut off valves are to conform to the requirements of the International Fuel Gas Code and the following standards, depending on gas pressure and application:**

1. ANSI Z21.15.
2. ASME B16.44
3. ASME B16.33

**B. General Requirements for Valves, NPS 2 and Smaller: Comply with ASME B16.33.**

1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.

3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
  6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.33.
1. CWP Rating: 125 psig (862 kPa).
  2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig (4140 kPa).
  8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 MOTORIZED GAS VALVES

- A. Automatic Gas Valves: Comply with ANSI Z21.21.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASCO Power Technologies, LP; Division of Emerson.
    - b. Eaton Corporation; Controls Div.
    - c. Eclipse Combustion, Inc.
    - d. Honeywell International Inc.
  2. Body: Brass or aluminum.
  3. Seats and Disc: Nitrile rubber.
  4. Springs and Valve Trim: Stainless steel.
  5. Normally closed.
  6. Visual position indicator.

- B. Electrically Operated Valves: Comply with UL 429.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASCO Power Technologies, LP; Division of Emerson.
    - b. Eclipse Combustion, Inc.
    - c. Goyen Valve Corp.; Tyco Environmental Systems.
    - d. Magnatrol Valve Corporation.
    - e. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
    - f. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  2. Pilot operated.
  3. Body: Brass or aluminum.
  4. Seats and Disc: Nitrile rubber.
  5. Springs and Valve Trim: Stainless steel.
  6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
  7. NEMA ICS 6, Type 4, coil enclosure.
  8. Normally closed.
  9. Visual position indicator.

## 2.6 PRESSURE REGULATORS

- A. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  2. Springs: Zinc-plated steel; interchangeable.
  3. Diaphragm Plate: Zinc-plated steel.
  4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  5. Orifice: Aluminum; interchangeable.
  6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  9. Overpressure Protection Device: Factory mounted on pressure regulator.
  10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  11. Maximum Inlet Pressure: 5 psig.
- B. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Body and Diaphragm Case: die-cast aluminum.
  2. Springs: Zinc-plated steel; interchangeable.
  3. Diaphragm Plate: Zinc-plated steel.
  4. Seat Disc: Nitrile rubber.
  5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 5 psig.

## 2.7 DIELECTRIC FITTINGS

### A. Dielectric Unions:

1. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

## 2.8 PIPE STANDS

### A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

### B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Accessories: Protection pads.

## 2.9 LABELING AND IDENTIFYING

### A. Provide pipe identification for all gas piping installed. The identification markers shall have a yellow label with the word "GAS" marked in black letters. Spacing shall be per the requirements of the International Fuel Gas Code. Where there are two or more meters the piping for each system shall be labeled so that the piping system supplied by each meter is identifiable.

### B. Below Grade Gas Piping: Provide warning tape per the following:

1. Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- B. Underground natural-gas piping shall be:
  - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
  - 2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping and provide cathodic protection per manufacture's installation requirements.

3.2 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 5 PSIG

- A. Aboveground branch piping shall be:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- B. Underground, below building, piping shall be **one of** the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.3 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Two-piece, full-port, bronze ball valves with bronze trim.

3.4 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.5 OUTDOOR PIPING INSTALLATION**

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Install fittings for changes in direction and branch connections.
- E. 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.
- F. 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.
- G. All piping to be installed a minimum of 4" above grade. Where gas piping is located on a roof surface, the pipe shall be a minimum of 4' above the surface and properly supported.
- H. Install pressure gage upstream and downstream from each service regulator.

**3.6 INDOOR PIPING INSTALLATION**

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. 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. Locate valves for easy access.

- F. Install natural-gas piping with a slope conforming to the requirements of the International Fuel Gas Code. Install piping free of sags and bends. Install fittings for changes in direction and branch connections.
- G. Install escutcheons at penetrations of interior walls, ceilings, and floors.
- H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials.
- I. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- J. Extend relief vent connections to service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap. Where regulators or other devices requiring a vent connection are located on the outdoors, provide vent cap on the relief vent connection.
- K. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- L. Concealed Location Installations: install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap or open ended exposed to view.
- M. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- N. Connect branch piping from top or side of horizontal piping.
- O. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- P. Do not use natural-gas piping as grounding electrode.
- Q. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- R. Install pressure gage upstream and downstream from each gas regulator.



**3.7 VALVE INSTALLATION**

- A. Install a manual gas shutoff valve, in an accessible location, at the gas connection to all gas fired equipment and/or gas fueled appliances. Shutoff valves to be installed per the following requirements:
  - 1. The valve is to be located within the same room as the equipment.
  - 2. The valve is to be located within 6'-0" of the equipment.
  - 3. The valve shall be installed upstream of the union, connector or disconnect device.
- B. Shutoff valves connected to emergency generators and other gaseous fueled equipment are to be installed per NFPA 37.

**3.8 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- C. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.
  - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

**3.9 HANGER AND SUPPORT INSTALLATION**

- A. Pipe hangers and supports shall conform to the requirements of MSS SP-58.
- B. Support vertical piping at base and at each floor with a maximum spacing of 120".
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS ¾ and NPS 1: Maximum span, 96 inches.
  - 2. NPS 1-1/4 and larger: Maximum span, 120 inches.

D. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

3.10 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment. Provide flexible corrugated and braided hose connector at equipment connection.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.11 LABELING AND IDENTIFYING

- A. Provide Identification and Labeling of all gas piping systems and components as required by the International Fuel Gas Code.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below sub-grade under pavements and slabs.
- C. Provide Stencil labels to all outdoor roof mounted gas piping.

3.12 PAINTING

- A. Paint all exposed, exterior steel piping, valves, service regulators, service meters and meter bars, valves, and piping specialties, except components, with factory-applied paint or protective coating.
  1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel semigloss.
    - d. Color: Gray or Yellow.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.13 FIELD QUALITY CONTROL

- A. Perform all required tests and inspections. Refer to Section 406 of the International Fuel Gas Code for requirements.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

END OF SECTION 221620

**SECTION 223306 – ELECTRIC DOMESTIC WATER HEATERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes Commercial Electric Domestic water heaters and accessories.

**1.3 SUBMITTALS**

- A. Product Data: For each domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Provide wiring diagrams for power, signal, and control wiring.
- C. Domestic Water Heater Labeling: All Tankless Electric Domestic Water Heaters shall be third party certified per the requirements of the International Plumbing Code.
- D. Warranty: Provide Manufacturer's warranty.
- E. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain all Electric Domestic Water Heaters through one source and from a single manufacturer, regularly engaged in production of the required components.
- B. Electrical Components are to be UL Listed and labeled.

**1.5 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. The manufacturer shall be providing a full warranty for a period of 1 year from the date of Substantial Completion. The warranty shall cover replacement of any defective part including labor and material.
- B. Storage Tank Warranty: The manufacturer shall provide a 3-year, a full warranty for the first 3 years and a prorated 5-year warranty for the final 5 years, for coverage for manufacturing or material defects, leaks, production of rusty water and/or chloride stress corrosion cracking. Tank warranty does not require inspection and maintenance of anode rods.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide Electric Domestic Water Heaters manufactured by one of the following. Subject to review, equipment meeting the full requirements of the specifications and any project installation limitations and manufactured by the following will be considered:
  - 1. Rheem.
  - 2. Bradford White.
  - 3. A. O. Smith
- B. The water heaters shall be ETL listed as a complete unit. The heater shall satisfy current Federal Energy Policy Act standards for both thermal efficiency and stand-by heat losses.

2.2 DOMESTIC WATER HEATER CONSTRUCTION

- A. The storage section of the water heater shall be ASME HLW stamped and National Board Registered for a maximum allowable working pressure of 150 psi and pressure tested at 1-1/2 times working pressure.
- B. All tank connections/ fittings shall be nonferrous. Tank shall be equipped with a ball-type drain valve. Tank design will include a manway sized access to the tank interior.
- C. The storage tank shall be Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings."
- D. Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
- E. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.

- F. Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
- G. Heating elements will be rated at 9 kW and 40 watts per square inch heat density
- H. Heating elements will be sheathed in Incoloy. Each element will individually mount to the tank by means of a four-bolt bronze flange over stainless steel studs with an o-ring seal. A fused magnetic contactor will be supplied for each power circuit. Maximum current per circuit will be 50 amps on three-phase units.

### 2.3 DOMESTIC WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
  - 1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
  - 2. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
  - 3. Capacity and Characteristics: refer to contract drawings for model numbers.
  - 4. Provide all required accessories including, heat trap fitting, relief valve and pressure gauge.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Where indicated on the contract drawings install domestic-water heaters on concrete base.
- B. Install electric, domestic-water heaters level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic water supply piping to domestic-water heaters and on domestic-hot-water outlet piping.
- C. When temperature and pressure relief valves are not furnished with the water heaters install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks.
- D. Extend relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains.

- F. Install thermometers on outlet piping of domestic-water heaters.
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.
- I. Charge domestic-water compression tanks with air.
- J. Install expansion tank and all required accessories including, relief valve and pressure gauge.

### 3.2 CONNECTIONS

- A. Where installing piping adjacent to domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections as recommended by the manufacturer.
- B. Leak Test: After installation fill system and test for leaks. Repair leaks and retest until no leaks exist
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare final test and inspection reports.

### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain electric domestic-water heaters.

END OF SECTION 223306

**SECTION 224000 - PLUMBING FIXTURES**

**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 conventional plumbing fixtures and related components.

**1.3 SUBMITTALS**

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

**1.5 WARRANTY**

- A. All equipment, material and labor provided under this specification section shall be warranted for a period of one year after project completion.



1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
  - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Water Closets - subject to compliance with requirements, provide products by one of the following:
  - 1. Sloan Valve Company.
  - 2. Zurn Plumbing Products Group
- B. Urinals - subject to compliance with requirements, provide products by one of the following:
  - 1. Sloan Valve Company.
  - 2. Zurn Plumbing Products Group.
- C. Lavatories: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sloan Valve Company.
  - 2. Zurn Plumbing Products Group.
- D. Service Sinks/Mop Receptors: Subject to compliance with requirements, provide products by one of the following:
  - 1. Zurn Plumbing Products Group.
  - 2. Kohler Co.
  - 3. Crane Plumbing, L.L.C./Fiat Products.
- E. Water Coolers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acorn Engineering Company.
  - 2. Oasis
  - 3. Halsey Taylor.

- F. Flushometers and Lavatory Faucets: Subject to compliance with requirements, provide products by one of the following:
1. Sloan Valve Company.
  2. Zurn Plumbing Products Group; Commercial Brass Operation.
- G. Toilet seats: Subject to compliance with requirements, provide products by one of the following:
1. Bemis Manufacturing Company.
  2. Church Seats.
  3. Eljer.
  4. Kohler Co.
  5. Olsonite Corp.
- H. Fixture Supports: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company
  2. Smith, Jay R. Mfg. Co.
  3. Tyler Pipe; Wade Div.
  4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  5. Zurn Plumbing Products Group; Specification Drainage Operation.
- I. Sink Faucets: Subject to compliance with requirements, provide products by one of the following:
1. Moen Commercial
  2. Chicago Faucets
  3. Zurn Plumbing Products Group; Commercial Brass Operation.
  4. Elkay Manufacturing Co.
  5. Just Manufacturing Company.
  6. Speakman Company.
  7. T & S Brass and Bronze Works, Inc.
  8. American Standard
- J. Commercial Sinks: Subject to compliance with requirements, provide products by one of the following:
1. Advance Tabco
  2. Elkay Manufacturing Co.
  3. Just Manufacturing Company.
  4. Eagle Group.
- K. Wash fountains: Subject to compliance with requirements, provide products by one of the following:
1. Acorn Engineering Company.
  2. Bradley Corporation.

- L. Emergency Combination Eyewash/Shower Units: Subject to compliance with requirements, provide products by one of the following:
  - 1. Encon Safety Products.
  - 2. Guardian Equipment Co.
  - 3. Haws Corporation.
  - 4. Acorn Safety.
  
- M. Protective Shielding Pipe Covers: Subject to compliance with requirements, provide products by one of the following:
  - 1. TRUEBRO, Inc.
  - 2. McGuire Manufacturing Co., Inc.
  - 3. Plumberex Specialty Products Inc.

## 2.2 FIXTURES

- A. F1 - Water Closet (ADA):
  - 1. Sloan complete HET water closet system; WETS-2450.1320 ST2459, elongated vitreous china bowl, 1.28 gallon per flush, siphon jet, wall mounted. Color shall be white.
  - 2. Seat: White open front solid plastic.
  - 3. Flush Valve: Sloan 111 ESS; 1.28 gpf: Hardwire sensor operated.
  - 4. Hanger: J. R. Smith.
  
- B. F2 - Lavatory - (ADA):
  - 1. Sloan wall hung lavatory model SS-3117; white vitreous china; self-draining deck; with contoured back and side splash shields; faucet ledge.
  - 2. Faucet: Sloan Optima ETF-600-BOX-BDT-CP-0.5GPM-MLM-IR-FCT; 4" center-set, below deck transformer hardwired sensor metering faucet with escutcheon plate, 0.5 gpm max laminar flow discharge @ .25 or .20 gpc, provide ASSE 1070 mixing valve and integral checks.
  - 3. Drain: chrome grid drain; chrome tailpiece and P-trap.
  - 4. Supplies: chrome angle supplies with loose key stops.
  - 5. Lav Guard: Truebro Lav Shield.
  - 6. Carrier: J. R. Smith.
  
- C. F3 - Water Cooler – Split Level w/ Bottle Filler:
  - 1. Elkay Modular model EZOOTL8WSLK barrier free with bottle filling station, pushbutton activated; rated for 8 gallons per hour at 50 deg F.; Light Grey Granite finish.
  - 2. Supply: provide isolation valve in an accessible location on the supply pipe.
  - 3. Drain: provide chrome p-trap.
  - 4. Voltage; 120-1-60.

- D. F4 - Mop Receptor.
1. Fiat model TSB3000; 24" x 24" x 12" precast terrazzo; floor-mounted; mop basin with 3" drain.
  2. Faucet: Fiat service faucet model 830-AA or equal; 3/4" hose thread on spout; bucket hook; wall brace; vacuum breaker; chrome finish.
  3. Additional single faucet: T & S Brass Model B-720-POL; 3/4" hose outlet; vacuum breaker; chrome finish; lever handle; and B-0970-FE Atmospheric Backflow Preventer.
  4. Drain: stainless steel grid drain.
- E. F5 – Service Sink:
1. Advanced Tabco Floor Mount Stainless Steel Sink model FC-1-2424 type 304#14 stainless steel. 29"x30" x 16 1/2" deep. Two faucet holes and drain. The Plumbing contractor shall make final connections and provide all required valves, drain, fittings, traps etc.
  2. Faucet; Advanced Tabco model K-1; 8" polish chrome brass swing spout.
  3. Drain: K-40 twist drain.
- F. F6 - Emergency Eye Wash:
1. Guardian model G1814; Plumbed stainless steel 1-1/4" pipe, accessible, wall mounted, with eye/face wash equipment with flow regulator and stay-open control valve. Eye/Facewash set to deliver potable water at rate not less than 3.0 gpm for at least 15 minutes hand treadle activated. Unit shall comply with ANSI Z358.1. Provide stainless steel bowl cover and chrome plated tailpiece and trap.
  2. Thermostatic Mixing Valve: Guardian model G3600LF Emergency Tempering Valve rated for 10 GPM at 20 psig. Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
  3. Lav Guard: Truebro Lav guard pipe insulation kit.
- G. F7 - Wash fountain:
1. Bradley Pre-Assembled three person; MF2939; Terreon solid surface construction. Standard Color to be selected by Architect. Furnish with infrared sensor metering control. 0.5 gpm spray nozzle for each user.
  2. Provide electronic controlled solenoid valve and 120/24 VAC transformer.
  3. Supplies: ASSE 1070 mixing valve with check stops.
  4. Provide drain and vent connections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
- C. Use carrier supports with waste fitting and seal for back-outlet fixtures.
- D. Use carrier supports without waste fitting for fixtures with tubular waste piping.
- E. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- F. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- G. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- H. Install wall-mounting fixtures with tubular waste piping attached to supports.
- I. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- J. Install counter-mounting fixtures in and attached to casework.
- K. Install fixtures level and plumb according to roughing-in drawings.
- L. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation
  - 1. Exception: Use ball if supply stops are not specified with fixture. Valves are specified in Division 22 Section "Valves."
- M. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- N. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- O. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- P. Install toilet seats on water closets.
- Q. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

- R. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- S. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- T. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.
  - 1. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts. Remove sediment and debris from drains. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

**SECTION 230010 - BASIC REQUIREMENTS – HVAC CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings 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 general administrative and procedural requirements for HVAC installations. Administrative and procedural requirements are included in this Section and in Division 1 specifications.

**1.3 PERMITS AND FEES**

- A. The contractor shall obtain and pay for all permits, inspection fees and licenses required by the local authority.

**1.4 PROJECT SCHEDULE**

- A. Refer Division 1 specifications for the project schedule.

**1.5 SHOP DRAWINGS AND SUBMITTALS**

- A. Follow the procedures specified in the applicable Division 1 specification sections and refer to individual sections of the Division 23 specifications for additional shop drawing and submittal requirements.
- B. It is the responsibility of the contractor to thoroughly review any and all shop drawings prior to submission to the Architect/Engineer. The contractor's review shall include verifying conformance to the project documents. The contractor will also be responsible for verifying the quantities of materials are adequate.
- C. All shop drawings shall be submitted with a cover sheet indicating the name of the project, the Architects and Engineers name, the name of the vendor and the contractor. There must be sufficient space on the title sheet to allow the appropriate stamping by both the Architect and the Engineer. Shop drawings and submittals not conforming to the above may be returned without review.
- D. All shop drawing submittals will include a listing of any and all exceptions to the requirements indicated in the specifications and/or on the drawings. Where there are no exceptions, the submittals shall indicate such. Submittals that do not have this listing will not be reviewed.



1.6 COORDINATION DRAWINGS

- A. Coordination drawings are required. Refer to applicable Division 1 specifications for work required by this Contractor in preparing Coordination Drawings.

1.7 INSTALLATION ACCESSIBILITY

- A. The installation of all equipment and appurtenances shall be completed so that access and clearances meet the requirements of the equipment manufacturer as well as the requirements of all applicable codes.

1.8 ACCEPTABLE MANUFACTURERS

- A. The design of the mechanical systems is based on the equipment manufacturer indicated on the drawings. Although individual sections of the specifications may list other manufacturers, these manufacturers will be accepted only if the following occurs:
  - 1. Performance, as judged by the engineer, must be equal to the design based equipment.
  - 2. Operating characteristics, as judged by the engineer, must be identical to those of the design based equipment.
  - 3. Physical size of the equipment must be such that it can be installed in the available space, maintaining all required clearances for access/maintenance and meet the architectural requirements of the project such as installed height, length, width and operating weight. The contractor shall be responsible for verifying the equipment meets this requirement.
  - 4. The contractor will be responsible for any costs associated for additional supports, changes in electrical wiring, piping changes, ductwork changes and / or controls that may be required if equipment other than the design based is used.

1.9 RECORD DOCUMENTS

- A. Prepare record documents in accordance with applicable Division 1 specification sections. In addition to the requirements specified, indicate the following installed conditions:
  - 1. Mains and branches of duct and piping systems, with valves, dampers and control devices, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
  - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  - 4. Contract Modifications, actual equipment and materials installed.
  - 5. Record Documents are to be prepared and/or revised to indicate the room names and numbers to be used by the owner after the projects is complete.

1.10 OPERATING AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with applicable Division 1 specification section.

1.11 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.
- B. When materials and products are stored on site, provide protection from weather and temperatures that may cause damage to the items.

1.12 EXTRA MATERIALS

- A. Various specification sections may indicate extra materials (filters, fan belts etc.) that are to be provided with the respective equipment. Where indicated, the contractor shall provide the required extra materials. When directed by the owner's representative, the contractor shall install the extra filters in the respective equipment. If no additional installation is required, the contractor shall forward all extra materials to the owner and obtain a receipt for any materials forwarded.
- B. The contractor shall also provide a list of all filters sizes for each type and size of unit provided on the project.

PART 2 - PRODUCTS (Not Used)

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. Obtain equipment shop drawings for the various items that require rough-in.

3.2 MECHANICAL INSTALLATIONS

- A. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
  - 2. Verify all dimensions by field measurements.
  - 3. Coordinate requirements for chases slots, and openings in other building components during the progress of construction, to allow for mechanical installations.
  - 4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  - 6. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised

service companies, and controlling agencies. Provide required connection for each service.

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. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
10. Install systems, materials, and equipment giving right-of-way priority to the systems required to be installed at a specified slope.
11. Seal all places where piping or ducts pass through walls and floors.

### 3.3 CUTTING AND PATCHING

- A. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
  1. Uncover Work to provide for installation of ill-timed Work.
  2. Removal and replacement of defective Work.
  3. Remove and replace Work not conforming to requirements of the Contract Documents.
  4. Remove samples of installed Work as specified for testing.
  5. Install equipment and materials in existing structures.
- B. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- C. In areas of the building where new finishes are being provided, the patching required on a surface which is to receive a new finish will be to bring the underlying surface up to the finish required to receive the final finish. This contractor shall coordinate subsurface finish requirements with the finish trade contractor(s).
- D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- E. Patch existing 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.

### 3.4 CLEANING

- A. This contractor shall be required to thoroughly clean all installed equipment, duct work and piping. Cleaning shall be required before substantial completion on any phase of the project. Do not use cleaning materials and agents that are hazardous to health or property or that may damage the finished surfaces.

END OF SECTION 230010

**SECTION 230030 – ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical connections to equipment specified under other Divisions or furnished by Owner.

**1.2 REFERENCES**

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electric Code.

**1.3 COORDINATION**

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Divisions.
  - 1. Should there be a difference between the design and the installed equipment; change orders shall only be paid for the difference in the rough-ins. If the Division 26 Contractor installs any rough-ins prior to requesting and receiving shop drawings for the equipment to be installed, and the equipment is different than designed, the required rework shall be performed at no additional cost to the owner aside from the difference is cost between the design documents and installed equipment.
  - 2. Should there be a need to install rough-ins ahead of equipment review and final shop drawing, the Division 26 Contractor shall submit a Request for Information, outlining the equipment to be fed, and how the schedule is impacted for review by the Engineer, Architect, Owner and Owner's Representative.
- B. Determined connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

**PART 2 - PRODUCTS**

**2.1 CORDS AND CAPS**

- A. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- B. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- C. Cord Size: Same as rating of branch circuit overcurrent protection.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
- B. The Contractor shall be responsible to coordinate all electrical which are installed for roof top equipment. Refer to "Coordination" in Section 260010 for additional requirements.

**3.2 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

**3.3 ELECTRICAL CONNECTIONS**

- A. Electrical connections shall meet equipment manufacturer's instructions.
- B. Conduit connections to equipment shall use flexible conduit. Liquidtight flexible conduit with watertight connectors shall be used in damp or wet locations.
- C. Wiring connections shall use wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Receptacle outlets shall be used where connection with attachment plug is indicated. Where attachment plug is required, equipment shall have a cord and cap.
- E. Suitable strain-relief clamps and fittings shall be used for cord connections at outlet boxes and equipment connection boxes.
- F. Disconnect switches, controllers, control stations, and control devices shall be located as indicated and per NEC requirements.
- G. Verify proper rotation of three phase equipment.
- H. Where applicable, power wiring shall be extended through external disconnect switches, local control switches, remote mounted control panels, etc. and connected to terminals in the equipment.
- I. Where applicable, wire and conduit shall be extended between control device (start/stop pushbuttons or lighted handle switch) and combination starter/disconnect switches.
- J. Coolers and Freezers: freezer and cooler walls, floors and ceilings shall be cut and sealed around conduit openings.

**3.4 MISCELLANEOUS CONNECTIONS**

- A. Fire alarm, security, data, telephone and other low voltage connections shall be installed as required at equipment.

**3.5 CONTRACTOR RESPONSIBILITIES (DIVISION 23 CONTRACT)**

**A. HVAC Control System Panels**

1. 120 volt – 1 phase.
2. Division 23 Contractor shall provide power connection to control panel from nearest 120/208 volt electrical panel. Power for control panels for equipment being fed from the emergency generator, including, but not limited to boilers, heating pumps, selected air handling and terminal equipment, etc., shall be derived from the nearest 120/208 volt normal/emergency panel.
3. Division 26 Contractor shall assist the Division 23 Contractor in locating the appropriate panel, ensure there is a spare 20A/1P breaker to feed the control panels and label breaker accordingly.
4. All wiring associated with the unit shall be by the Division 23 Contractor per manufacturer requirements.

**B. Duct-mounted Smoke Detector**

1. Division 26 Contractor shall furnish duct mounted smoke detector, including detector base and appropriately sized sampling tube for duct being installed.
2. Division 23 Contractor shall install sampling tube and detector base in duct. Coordinate exact location with Division 26 Contractor.
3. Division 26 Contractor shall install detector in base, wire and program into fire alarm system.
4. Division 26 Contractor shall provide relay, and wiring to associated HVAC unit from fire alarm system so that unit shuts down and supervisory signal is provided upon detection of smoke. Refer to Division 28 "Fire Alarm and Detection System" and drawings for additional requirements.
5. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

**C. Ambient Air Cleaner (AAC)**

1. 480 volt – 3 phase.
2. Starter to be furnished with the equipment.
3. Fused disconnect switch shall be furnished and installed by the Division 26 Contractor at the unit.
4. Division 26 Contractor to provide control as per drawings.

**D. Ductless Air Conditioner (DAC)**

1. 208 volt – 1 phase.
2. Thermal overload switch shall be furnished and installed by the Division 26 Contractor adjacent to unit. Provide 1-pole for 120V and 2-pole for 208V units.
3. Division 26 Contractor shall wire through switch and make one power connection to the line side terminals in the unit.
4. Power wire for AC unit shall come from the exterior unit.
5. All other wiring within the unit and between the unit and associated condensing unit shall be by the Division 23 Contractor per manufacturer requirements.

**E. Outdoor Packaged Air Handling Units (RTU)**

1. 480 volt – 3 phase.
2. All wiring from the input terminals to the respective devices in the unit shall be factory installed by the equipment manufacturer.

3. Starters with overload protection or variable frequency drive(s) for the fans shall be furnished and installed by equipment manufacturer.
  4. Division 26 Contractor shall make one power connections to the unit terminals.
  5. Unit shall be provided NEC approved overcurrent protection and disconnecting means in a unit mounted control panel. Equipment manufacturer shall wire all fans and other equipment from the input terminals.
  6. Equipment manufacturer shall provide control power transformer as required to power controls, unit lighting and convenience outlet and other 120V accessories as required.
  7. All other wiring in the unit shall be factory installed by the equipment manufacturer.
  8. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.
- F. Cabinet Unit Heaters (Electric) (ECH)
1. 120, 277 volt 1-phase, 480 volt – 3 phase.
  2. Fused disconnect switch in unit by equipment manufacturer.
  3. Division 26 Contractor shall make one power connection to the unit.
  4. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.
- G. Air Cooled Condensing Unit (CU)
1. 208 volt – 1 phase
  2. Division 26 contractor shall furnish and install a NEMA 3R fused disconnect switch at unit and shall extend power wiring thru switch to unit and shall make one connection to terminals in unit.
  3. Where CU is associated with an indoor AC, power wire for AC unit shall come from the exterior unit.
  4. All other wiring within the unit and between the unit and associated indoor unit shall be by the Division 23 Contractor per manufacturer requirements.
- H. Dust Collector (DC) Existing
1. Division 26 Contractor to electrically disconnect unit for relocation.
  2. 480 volt – 3 phase
  3. Relocated control panel by Division 23 Contractor.
  4. Division 26 Contractor shall relocate a fused disconnect switch and extend power wiring to the control panel and shall make one power connection.
  5. Division 26 Contractor shall relocate the remote mounted start/stop switch furnished with the unit and shall wire switch to control panel as required.
  6. Dust Switch device with all required Ct's shall be furnished by Division 23 Contractor. Division 26 Contractor shall install device per manufacturer requirements and connect to all devices that are fed by Dust Collector.
  7. Any other connections and/or equipment required shall be provided by Division 23 Contractor.
- I. Smoke Collector (WSC)
1. 480 volt – 3 phase
  2. NEMA 4, 3R factory wired, control panel with integral starters, control transformer and timers shall be furnished and installed by Division 23 Contractor.
  3. Division 23 Contractor shall furnish and install a fused weatherproof disconnect switch in control panel. Division 26 Contractor shall provide single point power wiring to the control panel.

4. Division 26 Contractor shall extend power to exterior blower per manufacturer requirements.
5. Division 26 Contractor shall provide a Nema 3R non fused disconnect switch at exterior blower location and provide power wiring from control panel through NFDS to blower and provide connections.
6. Division 26 Contractor shall install the remote mounted start/stop switch furnished with the unit and shall wire switch to control panel as required.
7. Smoke collector Switch device with all required Ct's shall be furnished by Division 23 Contractor. Division 26 Contractor shall install device per manufacturer requirements and connect to all devices that are fed by Smoke Collector.
8. Any other connections and/or equipment required shall be provided by Division 23 Contractor.

J. Indoor Fans – ATC Controlled (EF)

1. 120 volt – 1 phase.
2. Integral disconnect switch provided by the equipment manufacturer.
3. Thermal overload switch furnished and by the Division 26 Contractor; locate as indicated on drawings.
4. Division 26 Contractor shall install Division 23 Contractor speed control in space being service by fan. Coordinate location in field for balancing.
5. Division 26 Contractor shall make one power connection thru thermal overload switch and speed control where applicable.
6. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.

K. Roof Fans – ATC Controlled (EF)

1. 120 volt – 1 phase.
2. Integral disconnect switch provided by the equipment manufacturer.
3. Division 26 Contractor shall install Division 23 Contractor speed control in space being service by fan. Coordinate location in field for balancing.
4. Division 26 Contractor shall make one power connection through speed control where applicable.
5. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.
6. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

L. Unit Heaters Gas Fired (GUH)

1. 120 volt – 1 phase.
2. Thermal overload switch furnished and installed adjacent to unit by Division 26 Contractor.
3. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

END OF SECTION 230030





**SECTION 230500 – COMMON WORK REQUIREMENTS – HVAC CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings 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 materials and methods that are common to various HVAC installations.

**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.

**1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.
  - 3. Access Doors.

**1.5 QUALITY ASSURANCE**

- A. 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 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

- A. Manufacturers: Subject to review, provide access doors manufactured by Milcor, Inc or equal.
- B. Description: Steel access doors and frames for installation in masonry and/or drywall/gypsum board assemblies. Provide fire rated access doors when doors are installed in a fire rated assembly.
- C. Frames: minimum 16 gage steel with exposed nominal 1" flange around the perimeter of the unit. Where doors are to be installed in drywall/gypsum board assemblies provide frames with a drywall bead. Doors to be installed in masonry shall be furnished with adjustable metal masonry anchors.
- D. Flush Panel Doors: minimum 14 gage steel with concealed spring or piano hinge(s) with a minimum swing of 175 degrees. Finished with a factory-applied primer, suitable for field painting. Provide flush cylinder lock with key. Key all locks alike.
- E. Access door schedule: In addition to access door(s) that may be shown on the drawings provide the following access doors to be installed where directed by the architect or engineer:
  - 1. Five 16" x 16" to be installed in drywall/gypsum construction.
  - 2. Five 16" x 16" to be installed in masonry construction.

2.2 FIRESTOPPING

- A. The contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. All firestopping shall meet the requirements of ASTM E-814 and UL 1479. Firestopping for ducts shall be installed with materials and methods identified in UL Ventilation Duct Assemblies (HNLJ), V Series as applicable to the wall assembly specified.
- B. Subject to compliance with project requirements, firestopping materials may be provided by one of the following manufacturers:
  - 1. Specified Technologies Inc. (STI) Somerville, NJ.
  - 2. Tremco, Beechwood, OH.

2.3 TEMPORARY SMOKE DETECTORS

- A. The contractor shall provide a duct mounted smoke detector in the return air duct on all air handling units with a supply air capacity of 2000 c.f.m. or larger.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment to maintain unobstructed passageway of not less than 42" in width and 80" minimum head clearance as required by code.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.
- E. Install equipment to allow right of way for piping installed at required slope.

3.2 INSTALLATION OF PIPING UNDER EXISTING FLOORS

- A. Where the drawings indicate new piping is to be installed under existing slab-on-grade construction, the installing contractor will be required to verify the location(s) of any existing pipes, conduits or any other system components, that are required to remain in service, before saw cutting existing slabs.

3.3 ACCESS DOORS

- A. Comply with manufacturer's written instructions for installing access doors and frames. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces. Install doors flush with adjacent finish surfaces or recessed to receive finish material.
- B. Adjust doors and hardware after installation for proper operation. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.4 TEMPORARY SMOKE DETECTORS

- A. Provide a smoke detector in all air handling units as indicated in Part 2. The detectors are required to operate for temporary heating or cooling prior to substantial completion. All temporary duct detectors and associated wiring and controls shall be removed after permanent fire alarm system and associated duct detectors have been installed.

END OF SECTION 23 05 00

**SECTION 230570 - IDENTIFICATION FOR HVAC SYSTEMS**

**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 identification materials:
  - 1. Equipment markers.
  - 2. Duct markers.
- B. Refer to other Division 23 Specification Sections for requirements to label and identify materials, equipment and accessories relating to other components of the HVAC System(s).

**1.3 SUBMITTALS**

- A. Submit Product Data for type of marker and tag along with a schedule where each type will be installed.

**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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Provide identification materials available through Craftmark Pipe Markers or equal.

**2.2 EQUIPMENT MARKERS**

- A. Equipment Markers: 1/8" thick black plastic tag with engraved data in white letters, pre-drilled holes for permanent attachment on equipment.
  - 1. Minimum marker size: 4" wide by 2" high. Length and width to be larger if required for marker content.
  - 2. Minimum letter size: 1/2".

3. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate material.
4. Marker content: equipment name tag as shown on the drawings (i.e. AHU-1).

### 2.3 DUCTWORK IDENTIFICATION

- A. Manufactured self-adhesive vinyl peel off markers, 4" x 24" with bold 2" letters. Include airflow direction, duct service (such as supply, return, and exhaust and air handling system identification (i.e. AHU-2 SUPPLY AIR).

## PART 3 - EXECUTION

### 3.1 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment markers on each major item of HVAC equipment. Locate nameplates where accessible and visible. Nameplates are not required for HVAC equipment that is exposed to view in finished areas such as corridors, stairs, offices and classrooms. Include nameplates for the following general categories of equipment:
  1. Exhaust Fans.
  2. Industrial Ventilation Equipment.
  3. Air-cooled Condensing units
  4. Air Handling Units.

### 3.2 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts according to the following:
  1. Supply ducts.
  2. Return ducts.
  3. Outside air intake ducts.
  4. Exhaust ducts.
- B. Locate duct markers where ducts are above accessible ceilings, exposed in machine and/or equipment rooms and in maintenance spaces such as shafts, tunnels, and plenums as follows:
  1. Near each branch connection.
  2. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
  3. At access doors and similar access points.
  4. Near major equipment items and other points of origination and termination.
  5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

END OF SECTION 230570

**SECTION 230600 - HVAC SYSTEM TESTING, ADJUSTING, AND BALANCING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Testing, Adjusting and Balancing (TAB) work is to be provided a qualified TAB firm and shall be part of the HVAC Contractor's work.
- B. Work under this section includes, but is not limited to, Testing, Adjusting and Balancing (TAB) of the following air systems, water systems and HVAC equipment:
  - 1. All constant-volume and variable air volume systems.
  - 2. Air handling units.
  - 3. Terminal units such as cabinet heaters, unit heaters and convectors.
- C. All TAB work shall comply with the requirements of TAB procedures required by the Associated Air Balancing Council, National Environmental Balancing Bureau and ASHRAE.
- D. Coordinate and witness the installation work of the HVAC Contractor including all sub-contractors working for the HVAC Contractor and Electrical Contractor. Provide progress inspections of the work to ensure the installation of all systems is progressing as required and will operate as specified when completed. Report results of the progress inspection to the Owner's Representative.
- E. Submit balancing reports for all air systems.
- F. Validate the start-up and operation of all HVAC equipment and systems by the HVAC Contractor.
- G. Validate the start-up and operation of the HVAC Controls system. Submit reports indicating the operation of all equipment, throughout the range of operation, meets the requirement of the Sequence of Operations.

**1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.



1.4 SUBMITTALS

- A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified herein.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or AABC in the testing, adjusting and balancing of both air and water systems. The firm shall guarantee that all work will be performed in accordance with the applicable NEBB / AABC standards and procedures, and evidence of the firm's certification shall be provided for the engineer or designated owner's representative.
- B. The TAB firm shall have a minimum of 5 years' experience with projects of a similar size and scope.

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and portions of the existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations. Review the project's construction phasing plan and provide the necessary number of TAB visits to comply with the phasing plan.

PART 2 - PRODUCTS

2.1 DUCT ACCESSORY HARDWARE

- A. Instrument Test Ports: 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 the specified eternal duct insulation thickness. Provide special gaskets where test holes are to be installed in round or oval ducts. Test Ports to be Duro-Dyne model TH1, IP2 and/or IP4.

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. 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.
- B. Refer to the Contract Drawings for notes that relate to balancing of the air and water systems.
- C. Examine the approved shop drawing submittals for all HVAC systems and equipment prior to starting the TAB work.

- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section Metal Ducts, and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. 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.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. 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.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. 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. Verify all systems are complete, including controls, before starting the TAB work.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in the applicable NEBB or AABC standards.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors where required.
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish to meet the requirements of the installation.
- 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. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- C. 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.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.
- J. Where required, verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."
- K. Install instrument test holes in ducts at all required locations for testing and balancing purposes.
- L. Air Handling Unit(s) filters: Provide verification of controls and provide set points for monitoring the filter pressure drop in all air handling units where indicated in Specification Section 230905 HVAC Sequence of Operation. Provide adjustment when necessary.
- M. Building Pressurization: Provide verification of controls and provide set points for building pressurization control in various systems as indicated in Specification Section 230905 HVAC Sequence of Operation. Provide adjustment when necessary.
- N. Verify performance of air flow monitors. Measure outdoor air flow at all air flow monitors and verify the measured air flows are within 5% of the air flow indicated on the BMS. Provide verification in the final balancing report.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow. Measure air flows in main ducts and at terminal outlets and inlets.
  - 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. 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, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of branch ducts.
  - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 3. Re-measure each branch duct after all have been adjusted. Continue to adjust branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals. 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. 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.
- C. ECM Motors: Obtain and review manufacturer's information which indicates methods and procedures to balance air flow.

**3.7 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.
  4. Voltage and amperage input of each phase at full load and at each incremental stage.
  5. Calculated kilowatt at full load.
  6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Airflow.
  3. Air pressure drop.
  4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.

3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

### 3.8 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer. 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. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. 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 general data:
  1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name and location.
  4. Architect's and Engineer's name and address.
  5. Contractor's name and address.
  6. Report date.
  7. Signature of TAB supervisor who certifies the report.
  8. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  9. Summary of contents.
  10. Data for terminal units, including manufacturer's name, type, size, and fittings.
  11. Notes to explain why certain final data in the body of reports vary from indicated values.
  12. Test conditions for fans and pump performance forms.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
  1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Terminal units.
  4. Balancing stations.
  5. 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 w.g.
  - c. Fan rpm.
  - d. Discharge static pressure in inches w.g.
  - e. Filter static-pressure differential in inches w.g.
  - f. Dirty filter setpoint.
  - g. Preheat-coil static-pressure differential in inches w.g.
  - h. Cooling-coil static-pressure differential in inches w.g.
  - i. Heating-coil static-pressure differential in inches w.g.
  - j. Outdoor airflow in cfm.
  - k. Return airflow in cfm.
  - l. Outdoor-air damper position.
  - m. Return-air damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
- a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft.
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Total supply air flow.
  - b. Total system static pressure in inches w.g.
  - c. Fan(s) rpm.

- d. Discharge static pressure in inches w.g.
  - e. Filter static-pressure differential in inches w.g.
  - f. Dirty filter set point.
  - g. Preheat-coil static-pressure differential in inches w.g.
  - h. Cooling-coil static-pressure differential in inches w.g.
  - i. Heating-coil static-pressure differential in inches w.g.
  - j. Outdoor airflow in cfm.
  - k. Return airflow in cfm.
  - l. Outdoor-air damper position.
  - m. Return-air damper position.
  - n. Airflow monitor verification.
- G. Gas Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.
    - g. Output capacity in Btu/h.
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and rpm.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - 2. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm.
    - b. Entering-air temperature in deg. F.
    - c. Leaving-air temperature in deg. F.
    - d. Air temperature differential in deg. F.
    - e. Entering-air static pressure in inches w.g.
    - f. Leaving-air static pressure in inches w.g.
    - g. Air static-pressure differential in inches w.g.
    - h. Low-fire fuel input in Btu/h.
    - i. High-fire fuel input in Btu/h.
    - j. Manifold pressure in psig.
    - k. High-temperature-limit setting in deg. F.
    - l. Operating set point in Btu/h.
    - m. Motor voltage at each connection.
    - n. Motor amperage for each phase.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:



- a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h (kW).
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Air flow rate in cfm.
  - i. Face area in sq. ft.
  - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h.
    - b. Air flow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg. F.
    - e. Leaving-air temperature in deg. F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - 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 w.g.
    - c. Fan rpm.
    - d. Discharge static pressure in inches w.g.
    - e. Suction static pressure in inches w.g.

J. 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 w.g.
  - 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.

K. Air-Terminal-Device Reports:

1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Apparatus used for test.
  - d. Area served.
  - e. Make.
  - f. Number from system diagram.
  - g. Type and model number.
  - h. Size.
  - i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm.
  - b. Air flows for variable air volume units at the various settings (cooling, heating & minimum)
  - c. Air velocity in fpm.
  - d. Preliminary air flow rate as needed in cfm.
  - e. Preliminary velocity as needed in fpm.
  - f. Final air flow rate in cfm.
  - g. Final velocity in fpm.
  - h. Space temperature in deg. F.

L. 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-air temperature in deg. F.
- c. Leaving-air temperature in deg. F.

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.9 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing is 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.

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, submit the final report for review.
2. The Owner may 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.
3. 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."
4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.10 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 230600



**SECTION 230700 - HVAC SYSTEM INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes insulation materials and accessories for insulating HVAC ductwork.

**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. Duct insulation, including adhesives, shall have a flame spread index not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723, using the procedures of ASTM E2231. Duct coverings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250 degrees F.
- B. All insulation values are to meet the requirements of the applicable edition of the International Energy Conservation Code.
- C. Insulation installed on the exterior of ducts, located within the building, shall bear identification at intervals not greater than 36" with the name of the manufacturer, the R value at the specified installed thickness and the flame spread and smoke developed indexes of the composite materials.

**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. Store materials providing protection from the elements.

**1.6 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with the duct and piping.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. 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. Insulation conductivity (k) shall not exceed 0.27 Btu per inch/h – ft<sup>2</sup> – deg. F.
  - 1. Products: Subject to compliance with requirements, provide products manufactured by one of the following:
    - a. Armacell LLC; AP Armaflex.
    - b. Aeroflex USA Inc.; Aerocel.
- B. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136 with factory-applied FSK jacket. Insulation conductivity (k) shall not exceed 0.27 Btu per inch/h – ft<sup>2</sup> – deg. F.
  - 1. Products: Subject to compliance with requirements, provide Johns Manville Microlite insulation or equal products manufactured by one of the following:
    - a. CertainTeed Corp.
    - b. Knauf Insulation.
    - c. Owens Corning.

2.2 EXTERIOR DUCT INSULATION SYSTEM

- A. Fiberglass Wrap: Comply with ASTM C 1393, Type IIIA, IIIB, Category 2. Operating temperatures limits: 0 de. F. to 850 deg. F. Thermal conductivity 0.24 Btu per inch/(hr-ft<sup>2</sup>-Def. F. at 75 deg. mean temperature.
  - 1. Products: Subject to compliance with requirements, provide Johns Manville Micro-Flex large diameter Fiberglass Wrap or equal products manufactured by one of the following:
    - a. CertainTeed Corp.
    - b. Knauf Insulation.
    - c. Owens Corning.
- B. Jacketing: UV resistant PVC; 40 mil thick white.
  - 1. Products: Subject to compliance with requirements, provide Johns Manville Zeston 300 Series PVC jacketing.

2.3 CEMENTS, ADHESIVES, SEALANTS AND MASTICS

- A. Provide all required types of cements, adhesives, sealants, mastics and other accessories required to install all insulation materials and systems. Prepare surfaces as required by the insulation manufacturers. Install cements, adhesives, sealants and mastics per manufacturer's recommendations.

2.4 PVC PIPE JACKETING

- A. PVC jacketing, 30 mil thickness with flame spread of 25 or less and a smoke development of 50 or less. Temperature rating 150 degrees F.
  - 1. Subject to compliance with requirements, provide Johns Manville Zeston Jacketing or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes per the manufacturer's instruction 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 per manufacturer's instructions.
- 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.

### 3.2 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations. Seal penetrations with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- F. Insulation Installation at Floor Penetrations:
  - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Pipe: Install insulation continuously through floor penetrations.
  - 3. Seal penetrations through fire-rated assemblies.

### 3.3 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with adhesives to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulate all pipe fittings, elbows, valves and pipe specialties.
- C. Apply weather resistant coating on all exterior insulation to protect the insulation from ultraviolet rays. Provide Armaflex WB Finish water based coating or equal.

### 3.4 MINERAL FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes per manufacturer's instructions. Where vapor barriers are required, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c. 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, Elbows, 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.
  
- C. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins, apply adhesives according to manufacturer's recommended coverage rates per unit area.
  - 1. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - 2. 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.
  - 3. 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.

### 3.5 DUCT INSULATION SCHEDULE, GENERAL

- A. Duct systems requiring insulation on the exterior of the ducts:
  - 1. Indoor exposed and concealed supply air and outdoor air ducts.
  - 2. Indoor, exposed and concealed return air ducts located in an unconditioned space.
  - 3. Indoor, exposed and concealed exhaust between isolation damper and penetration of building exterior.
  - 4. Supply and return ducts located on the exterior of the building.
  - 5. Other locations noted on the drawings.
  
- B. Items Not Insulated:
  - 1. Ducts with interior duct liner, unless otherwise noted.
  - 2. Indoor exposed supply air ducts in heating only systems located in a conditioned space.
  - 3. Indoor, exposed and concealed return ducts located in conditioned space.
  - 4. Factory-insulated flexible ducts.
  - 5. Factory-insulated plenums and casings.
  - 6. Flexible connectors.
  - 7. Factory-insulated access panels and doors.

8. Other locations noted on the drawings.

### 3.6 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed supply air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 8.0; with vapor barrier having a maximum permeance of 0.05 perm.
- B. Concealed return air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 6.0; with vapor barrier having a maximum permeance of 0.05 perm.
- C. Exposed supply-air ducts, plenums and all hydronic coils shall be insulated with:
  1. Mineral-Fiber Board: 2 inches thick, 3-lb/cu. ft. density, "R" 8.7 with vapor barrier.
- D. Exposed return-air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Board: 1-1/2 inches and 3-lb/cu. ft. density, "R" 6.5 with vapor barrier.

### 3.7 EXTERIOR DUCT INSULATION SCHEDULE

- A. Provide an insulation system as specified in Part 2 consisting of 1" duct wrap and PVC jacketing. Provide adhesives to have a completely vapor sealed system.

### 3.8 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water Piping:
  1. All Pipe Sizes: Insulation shall be Flexible Elastomeric: 3/4 inch thick.
- B. Refrigerant piping and hot-gas piping:
  1. Flexible Elastomeric, 1" inches thick.

### 3.9 OUTDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Piping; all pipe sizes: Insulation shall be Flexible Elastomeric, 1 inch thick with PVC jacket.

END OF SECTION 230700

**SECTION 230900 – HVAC SYSTEM CONTROLS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to other HVAC Specification Sections which describe the requirements of the HVAC system components.
- C. Refer to Section 230905 “Sequence of Operation – HVAC Controls” for information related to the HVAC system controls.

**1.2 SUMMARY**

- A. This Section includes direct digital control (DDC) equipment for control of HVAC systems and various other systems.
- B. Refer to all Division 23 specification sections for controls that may be provided with the associated equipment.
- C. Work under this section includes, but is not limited to, providing the required controls and accessories to accomplish the method of control as indicated in Section 23 09 05, Sequence of Operation, for the following HVAC equipment:
  - 1. Packaged Air Handling Units.
  - 2. Exhaust fans.
  - 3. Sequence(s) that are indicated on the construction drawings.
- D. The Building Management System (BMS) installer / supplier shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as specified. Provide a complete and fully operational system. The system shall allow the Owner to have access through the internet with password security to suite the Owner's needs. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer.
- E. The BMS shall be an extension to the existing Schneider Electric control system currently used by the school.
- F. The BMS manufacturer/supplier shall be responsible for all BMS control wiring and power wiring for a complete and operable system. All wiring shall be done in accordance with all applicable local, state and national codes.
- G. The BMS installation must be supervised by personnel directly employed by the manufacturer/supplier.

- H. All existing controls, both pneumatic and electronic, are to remain operational during construction. At the completion of the project all existing pneumatic controls and the associated components will be removed. Provide the following to accommodate the phased construction schedule:
1. Temporary control and power wiring as required to accommodate the renovation phasing schedule.
  2. Temporary extensions to the existing pneumatic tubing where required.
  3. Remove control system components (i.e. wiring, pneumatic tubing, actuators) as phasing allows.
  4. Where existing pneumatic controls are to remain, verify the tubing and other system components are fully functional. Repair or replace components as required.
  5. Cap existing pneumatic tubing as needed.
  6. As construction phasing progresses provide extensions to the control system as needed and remove existing components that are no longer required.

### 1.3 DEFINITIONS

- A. DDC: Direct Digital Control
- B. BMS: Building Management System.
- C. BAS: Building Automation System.
- D. EMS: Energy Management System.
- E. PC: Personal computer.

### 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.
- B. 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.
- C. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
- D. 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.
- E. Shop Drawings: Provide detailed equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include the following:
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 hardware including:
    - 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 including:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
    - d. Points list.
- F. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.
  5. Software license required by and installed for the workstations and control systems.
  6. All system and software development tools are to allow the owner to independently maintain the system.
  7. Software Tools - All software tools needed for normal day to day operation and servicing shall be provided. Any such changes to the designated license holders shall be made by the manufacturer upon written request by the owner or his agent. Any cost associated with the license changes shall be identified within the BAS submittals.
  8. Programming Tools - Provide freely available Niagara AX Wizards to facilitate the programming and configuration of all of the BACnet devices that are provided for the HVAC and lighting control. Wizards shall be provided free of charge and be compatible with the current published versions of the network management tool that is provided as part of this project. The wizard software shall be available for public access from the manufacturer's web site. These wizard programming tools shall be compatible with at least 3 other brands of the Niagara Framework network management tools. The SI shall demonstrate as part of their prequalification as to how they intend to comply with these requirements.
- G. 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, include the following:

1. Interconnection wiring diagrams with identified and numbered system components and devices.
2. Keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

**1.5 SYSTEM PERFORMANCE**

- A. System shall have an open architecture utilizing the data infrastructure of fiber optic cables and/or copper cables to communicate between field panels.
- B. System server shall include the latest edition of Microsoft© windows operating system. Provide web-based browser graphic software to integrate the systems. System must be accessible remotely via the internet.
- C. Graphic software shall reside on the system server. The intent of the specification is to provide a BMS system operating with a Niagara 4 open framework which is truly open at all levels. Open by definition includes Sourcing, Product, Service and Expansion. Any contractor or integrator certified on Niagara 4 platform must be able to work on any device, network controller or supervisor without having to use other vendors to access any part of the BMS network.
- D. The graphic software shall provide a graphical representation of the building floor plan with icons/images to indicate HVAC system components and readings, generator annunciation, power metering information and locations and exterior lighting control. System software must interface with the separate systems to report activities by date, time.
- E. System shall log events for report trends, alarm conditions, etc through the Niagara software.

**1.6 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.
- C. UL listed to Standards UL864 (Fire), UL2017 (Signaling Systems), UL916 (Energy Management Systems), UL1017 (Security), UL1610 (Central Station) and UL 294 (Access Control).

**1.7 CODES AND STANDARDS**

- A. Meet the requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
- B. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
- C. Federal Communications Commission -- Part J.

- D. ASHRAE/ANSI 135-2016 (BACnet) - (System Level Devices) - Building Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.
- E. ASHRAE/ANSI 135-2016 (BACnet) - (Unit Level Devices) - Unit Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.
- F. EIA-709.1 LonTalk Standard and EIA 901.2 (LonMark Certification) - (Unit Level Devices) - Custom Application Controllers and Application Specific Controllers shall use FTT-10A transceivers and support the LonTalk communication protocol utilizing Standard Network Variable Types (SNVT) as defined by Echelon Corporation. This standard communication protocol provides interoperability with hundreds of other various building system manufacturers' control systems and devices.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

#### 1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

#### 1.10 WARRANTY

- A. The BMS supplier/installer shall warrant all work per the following:
  - 1. All control systems labor, equipment and materials shall be warranted to be free from defects for a period of twelve (12) months after the date of substantial completion. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BMS manufacturer/installer shall respond to the Owner's request for warranty service within 24 hours of the initiated call.
  - 2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BMS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.
  - 3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by the Owner must be granted prior to the installation of these updates.
  - 4. The BMS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.



PART 2 - PRODUCTS

2.1 INSTALLERS

- A. Subject to compliance with requirements provide HVAC controls with products furnished, engineered, and installed by one NRG Controls, Inc. located in Harrisburg, PA.

2.2 DDC EQUIPMENT

- A. Operator Workstation: Provide updates or replacement of the existing PC based workstation.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  - 3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti-short cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing when applicable.
    - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - e. Remote communications.
    - f. Maintenance management.
    - g. Units of Measure: Inch-pound.
  - 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  - 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
  - 1. Binary Inputs: Allow monitoring of on-off signals without external power.
  - 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  - 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  - 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
  - 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position auto-manual switch, and manually adjustable potentiometer].
  - 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  - 7. Universal I/Os: Provide software selectable binary or analog outputs.
  
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
  - 1. Output ripple of 5.0 mV maximum peak to peak.
  - 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  - 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
  
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
  - 1. Minimum dielectric strength of 1000 V.
  - 2. Maximum response time of 10 nanoseconds.
  - 3. Minimum transverse-mode noise attenuation of 65 dB.
  - 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

### 2.3 BUILDING CONTROLLERS

- A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.
- B. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.
- C. The controller shall provide a USB communications port for connection to a PC.
- D. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
- E. All System Controllers shall have a real time clock.
- F. Data shall be shared between networked System Controllers.

- G. The System Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
  - 1. Assume a predetermined failure mode.
  - 2. Generate an alarm notification.
  - 3. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
  - 4. Automatically reset the System Controller to return to a normal operating mode.
  
- H. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at -40° F to 122° F.
  
- I. Clock Synchronization:
  - 1. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.
  - 2. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.
  - 3. All System Controllers shall automatically adjust for daylight savings time if applicable.
  
- J. Serviceability:
  - 1. Provide diagnostic LEDs for power, communications, and processor.
  - 2. The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
  - 3. All wiring connections shall be made to field removable, modular terminal connectors.
  - 4. The System controller shall utilize standard DIN mounting methods for installation and replacement.
  
- K. Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System controller.
  
- L. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.
  
- M. Uninterruptible Power Supply: 1.5kVA. Provide 30 mins of backup power after loss of power.
  
- N. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs with a minimum BACnet Protocol Revision of 14.

## 2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
  
- B. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.

- C. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
- D. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
- E. BACnet Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
- F. Enclosure: Waterproof rated for operation at 40 to 150 deg F.T

## 2.5 PROGRAMMABLE CONTROLLERS

- A. Performance - Each PC shall have a minimum of 64K of Non-volatile Flash memory for control applications and 128K non-volatile flash memory for storage with an 8 bit processor. The PC shall have a minimum ambient operating temperature range of -0°C to 70°C or 32°F to 158°F.
- B. Inputs - Analog inputs shall have the following minimum level of performance: 16-bit A to D resolution; allow monitoring of platinum 100 ohms, platinum 1000 ohm, nickel 1000 ohms, thermistor 10K type II, thermistor 10K type III, voltage input 0-10VDC, current input 4-20mA, digital input, pulsed input minimum 2 Hz.
- C. Outputs - Outputs shall be either software configurable to be either analog or digital or dedicated digital only - Analog outputs shall be selectable as voltage of 0-10 VDC (linear) or 4-20mA or Digital outputs shall be 0-12 VDC (off/on), floating or PWM. Outputs shall have an adjustable range of 2 seconds to 15 minutes. Output Resolution shall be a minimum 8 bits digital/analog converter. All individual outputs and power supply shall be protected by an auto reset fuse. There shall be an LED status indicator on each of the outputs.
- D. Programmable Controller Features:
  - 1. Provide an onboard network communication jack.
  - 2. The PC shall be provided with a diagnostic indicator lights for power and network communication of transmit and receive along with a light indication position for each output.
  - 3. Hand/Off/Auto Switches - For all controllers applied to an AHU, Chiller, Pumps, Cooling Tower or Boiler, provide for the manual override and adjustment of all Analog and Digital outputs through a three-position switch giving the selection of Hand, Off and Auto (HOA). A HOA shall be provided for each separate digital and analog output from the controller and be an integral part of the controller. HOA switches external from the controller shall not be accepted. For the Analog outputs the Hand position of the switch shall provide for the adjustment of the output signal through a linear scaled potentiometer. The position of the HOA shall be monitored and an alarm shall be delivered to the Graphical User Interface should the switch be in an Off or Hand position. An indicating LED shall be provided on the controller for each HOA indicating position of the switch. For all Analog outputs, the indicating LED shall provide a linear indication of the position of the Potentiometer through a variation in the intensity of the indicator LED and be provided as a numerical value that can be viewed at the Graphical User Interface.

4. Enclosures - Provide for a plastic enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.
- E. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

## 2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Humidity Sensors: Bulk polymer sensor element.
  1. Duct sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
  2. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
- C. Static pressure transmitters: non-directional sensor with suitable range for expected input, and temperature compensated.
  1. Accuracy: 2 percent full range with repeatability of 0.5 percent.
  2. Output: 4 to 20 mA.
  3. Building Static-Pressure Range: 0- to 0.25-inch wg.
  4. Duct Static-Pressure Range: 0- to 5-inch wg.
- D. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure.
- E. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig.
- F. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
- G. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system.

## 2.7 ROOM SENSORS

- A. Sensors shall be of the thermistor type and shall be recessed wall box mounting type per the following:
  1. LCD display to indicate sensed values
  2. Set points: warmer/cooler adjustment, which can be programmed in the system to a maximum number of +/- degrees of adjustment
  3. Temperature sensing accuracy: +/- 1 degree F.
    - a. Range: 40 to 104 deg. F.
    - b. Accuracy: +/- 1 deg. F.

4. Humidity sensing accuracy:
  - a. Range: 20% to 90%
  - b. Accuracy: +/- 3%.
5. CO2 sensing where indicated on the drawings or in specification section 230905.
  - a. Range: 0 to 2000 ppm.
  - b. Accuracy: +/- 30 ppm or 3% of the reading.
6. Where indicated in Part 3 provide cage style metal wire guards for room sensors including but not limited to temperature sensor, temperature/humidity sensors and CO2 sensors.

## 2.8 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

## 2.9 CO2 SENSORS

- A. Carbon Dioxide sensors shall measure CO2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated on the drawings or in the sequence of operation.

2.10 ACTUATORS

- A. Modulating valves and dampers: provide proportional modulating control capable of positioning the valve or damper at all points across the full range of operation with continuous control action. The sensor, controller and control device (damper, valve, etc.) shall act as one unit to maintain a constant and precise control of the controlled medium. Actuator drives proportional to input signal and modulates throughout its angle of rotation.
- B. Two-position valves and damper: provide two-position actuators only where indicated.
- C. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 2. Non-spring Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 3. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
  - 4. Non-spring Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. Size for running and breakaway torque of 150 in. x lbf.
- D. Electric Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Provide full modulating damper and valves actuators unless otherwise noted.
  - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  - 3. Dampers: size for required torque calculated as follows:
    - a. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - c. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
  - 4. Coupling: V-bolt and V-shaped, toothed cradle.
  - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring return actuators.
  - 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

2.11 DAMPERS

- A. Dampers: AMCA-rated, opposed blade design; 0.108-inch minimum thick, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
- B. Edge Seals: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 4 cfm per sq. ft. of damper area, at

differential pressure of 4-inch wg when damper is held by torque of 50 in. x lb f; when tested according to AMCA 500D.

**2.12 PRESSURE TRANSDUCERS**

- A. Transducer shall have linear output signal. Zero and span shall be field adjustable. Sensor accuracy shall be 1 percent of full scale with repeatability/long-term stability of 0.25 percent.
- B. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
- C. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
- D. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.
- E. Selectable rate pulse output for kWh reading, 4-20 mA output for kW reading, N.O. alarm contact, and the ability to operate with 5.0 amp current inputs or 0-0.33 volt inputs.
- F. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120-600V, and auto range select.
- G. Under voltage/phase monitor circuitry.
- H. NEMA 1 enclosure.
- I. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0 - 0.33 V output. If 0-5 A current transformers are provided, a three-phase disconnect/ shorting switch assembly is required.

**2.13 AIR PURIFICATION – BIPOLAR IONIZATION**

- A. Provide control relay for control of all bi-polar ionization units. Multiple ionizer modules can be powered and controlled from a single relay where multiple modules are included in a single air handling unit.
- B. Associated control transformers shall be capable of supplying additional power required for the bipolar ionizers.
- C. Provide all wiring required to power ionization units when supply fan is energized.



PART 3 - EXECUTION

3.1 INSTALLATION

A. Electrical power:

1. Verify that power supply is available to the operator workstation, all actuators, valves and all other components of the HVAC Control System. Where required, provide low and/or line voltage power from the nearest electrical panel.
2. Unless noted otherwise, line voltage power for system equipment shall be derived from the nearest electrical panel, and shall not be common with other HVAC, plumbing, electrical or architectural equipment. Unless noted otherwise, low voltage power shall be derived from transformers/drivers associated with the system equipment only, and shall not be connected to control power transformers associated with other HVAC equipment (i.e. air handling units, chillers, etc.). System equipment may share transformers/drivers with other system equipment, provided the transformers/drivers are sized to handle the total load.
3. Control panels for equipment being fed from the emergency generator, including, but not limited to boilers, heating pumps, selected air handling and terminal equipment, etc., power shall be derived from the nearest 120/208 volt normal/emergency panel. Verify equipment that is connected to emergency power with the Electrical Contractor.
4. Install all power and control wiring and cable per the National Electric Code and applicable Division 26 and 27 Sections. Install raceways, boxes, cabinets according to Division 26 and 27 Sections.
5. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
6. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

B. Low Voltage Control Wiring:

1. Install low voltage control wiring per applicable Division 26 and 27 sections.
2. Wiring shall be installed concealed above accessible ceilings and within wall cavities. When run in wall cavities, install in 1" EMT conduit (flexible non-metallic conduit may not be used).
  - a. Low voltage control wiring may be installed in cable tray, when available; however, it shall be bundled together, neatly trained with Velcro straps, separated from the data wiring.
3. All backboxes for sensors and other wall devices shall be full power rated galvanized boxes. Low voltage rings may not be used.
4. Wiring installed in spaces with open structure, i.e. mechanical spaces, etc., shall be installed in minimum 1" EMT conduit. Conduit shall be painted to match structure.
5. In existing construction, open cavity walls (gyp, open core CMU, etc.) shall be fished. Surface metallic raceway (Wiremold V700 series) may be used where walls cannot be fished.
6. Where data cabling (category 5e or 6) is installed, cables shall be terminated on their own patch panel, and meet all requirements of Division 27 "Communications Cabling," including, but not limited to terminations, labeling, testing and warranty.

C. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

- D. Connect and configure equipment and software to achieve sequence of operation specified.
- E. Verify location of thermostats, humidistats, and other exposed control sensors with drawings and room details before installation. Install devices 48 inches above the floor.
- F. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- G. Install heavy duty aluminum guards on thermostats and other sensors.
- H. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- I. Furnish and install hydronic instrument wells, valves, and other accessories where required.
- J. Install refrigerant instrument wells, valves, and other accessories where required.
- K. Space sensors:
  - 1. Verify location of thermostats, humidistats, and other control sensors with Drawings and room details before installation. Mount sensors in occupied spaces to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
  - 2. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
  - 3. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
  - 4. In finished areas, recess electrical box within wall.
  - 5. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted.
  - 6. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.
- L. Bipolar Ionization Systems: Provide required wiring and controls to have a fully operational bipolar ionization system in the respective air handling equipment. Monitor the operating status of all bipolar ionization equipment as indicated in Specification Section 230905.

### 3.2 QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust all control system components. Report results in writing to the owner's representative.
- B. Perform field tests and inspections. At a minimum perform the following:
  - 1. Operational Test: After electrical circuitry has been energized, start all equipment to confirm proper operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust all controls and safeties.
  - 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC System Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check dampers. Verify that proper blade alignment, either parallel or opposed, has been provided.
9. Verify that DDC controller power supply is from emergency power supply, if applicable.
10. Verify that wires at control panels are tagged with their service designation and approved tagging system.
11. Verify that spare I/O capacity has been provided.
12. Verify that DDC controllers are protected from power supply surges.

### 3.3 CALIBRATION AND ADJUSTMENTS

A. Calibrate instruments. Make three-point calibration test for both linearity and accuracy for each analog instrument. 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.

1. Verify 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.
2. Verify 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.
3. 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.

4. 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.
  5. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
  6. 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.
  7. Provide diagnostic and test instruments for calibration and adjustment of system.
  8. 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.

### 3.4 SYSTEM DEMONSTRATION AND ON-SITE ASSISTANCE

- A. Pre-installation demonstration: the BMS Installer shall provide a complete demonstration of the proposed control system software architecture prior to final programming of the software. This demonstration is required to have the owner's representative agree on the system architecture including providing information on initial temperature set points desired by the Owner. The method and location of the demonstration shall be acceptable to the owner. The BMS Installer will be required to make any changes in the proposed system architecture, if desired by the owner's representative.
- B. Post installation demonstration: provide documented (paper or electronic) proof of testing prior to scheduling post-installation demonstration. Documentation to provide proof of testing/verification of all system inputs and outputs, including verification of analog input values (temp, CO2, etc.) with independent handheld NIST calibrated device. Post installation testing will engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. The training shall be comprised of a minimum of 16 hours on-site training at a time suitable to the owner's representative.
- C. On-site assistance: during the warranty period, the Controls Manufacturer/Installer shall provide additional on-site assistance for training and re-programming, when requested by the owner. This on-site assistance shall be for a period of 8 hours for each visit, with a total of 2 visits.

### 3.5 FINAL REVIEW

- A. Submit written report to Architect **and Owner's representative** when DDC system is 100% complete. Report shall state the following:
  1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
  2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
  3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
  4. DDC system is complete and ready for final review.

END OF SECTION 230900

**SECTION 230905 - SEQUENCE OF OPERATIONS – HVAC CONTROLS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes control sequences. Sequence of operation is hereby defined as the manner and method by which various controls and systems function.
- B. The requirements for the operation of each type of control system are specified in this section and / or on the contract drawings.

**1.3 SUBMITTALS**

- A. The control system supplier/installer shall review all HVAC equipment shop drawings prior to their shop drawing submission. The supplier shall note in the submission that all relative shop drawings have been reviewed prior to submission to the engineer.
- B. Shop Drawings: Submit shop drawings containing the following information:
  - 1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
  - 2. Label each control device with setting or adjustable range of control.
  - 3. Indicate difference between factory and field wiring.
  - 4. Indicate each control panel required, with internal and external piping and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling.
  - 5. Include verbal description of sequence of operation.
  - 6. Maintenance Data: Include copy of all shop drawings in each maintenance manual.
  - 7. When preparing submittals and programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal when a schedule is available, to reflect the proper room numbers.

**PART 2 - PRODUCTS**

Not Applicable

**PART 3 - EXECUTION**

**3.1 TEMPERATURE SETTINGS**

- A. All temperatures shown in the control sequences are indicated in degrees Fahrenheit and the settings shall be fully adjustable through the use of simple key strokes on the operator work station.
- B. Unless otherwise indicated in the sequences the initial settings are to be as follows:
  - 1. Unoccupied heating: 60 degrees F.
  - 2. Unoccupied cooling: 80 degrees F.
  - 3. Occupied heating: 70 degrees F.
  - 4. Occupied cooling: 75 degrees F.
  - 5. Space humidity: 58%.

**3.2 CONTROL SEQUENCE RTU-1**

- A. The BMS installer is required to review the packaged air handling unit shop drawings prior to submittal of control shop drawings to the Engineer. The BMS installer shall provide all required controls to ensure the units will function as indicated in the following sequence.
- B. The roof mounted packaged air handling unit is a single zone variable air volume unit and contains a variable speed supply fan, DX cooling, hot-gas reheat, modulating gas heat, barometric relief, filters, air flow monitoring, as well as other components.
- C. The unit shall be controlled by the BMS and shall be indexed to the occupied and unoccupied settings at the fully adjustable programmed times. Provide optimal start/stop programming.
- D. Provide a space thermostat / sensor / humidistat.
- E. Provide control wiring between the unit starter and a relay furnished by the electrical contractor to allow for fan(s) shut down when the fire alarm system activates. If activated close all outdoor air dampers.
- F. Outdoor air dampers are to fail in the closed position with return dampers failing in the open position.
- G. Provide an analog transducer to monitor and record pressure drop across the MERV 13 filters in the air-handling unit. An alarm will be activated at the BMS workstation if the actual filter pressure drop exceeds the dirty filter pressure drop established by the TAB Contractor.
- H. Unoccupied heating cycle:
  - 1. The supply fan will be off, the outdoor air damper closed and the return air damper open.
  - 2. When the space temperature falls below the unoccupied set point temperature start the supply fan at full speed and energize the gas heat. When the unoccupied set point temperature has been restored, reverse the above sequence.

- I. Unoccupied cooling cycle: Two modes of operation shall be available. One mode is to have no cooling with all fans off and the outside air damper closed. The second choice is for a higher space cooling set point, which is described as follows:
  - 1. The supply fan will be off, the outdoor air damper closed and the return air damper open.
  - 2. When the space temperature rises above the unoccupied set point temperature start the supply fan at low speed and energize the DX cooling to supply a 54 degree leaving air temperature. If required to maintain space temperature, slowly increase the fan speed and simultaneously increase the DX cooling to maintain a 54 degrees leaving air temperature. When the unoccupied space temperature has been restored, reverse the above sequence.
  - 3. Provide controls for economizer cooling. If the enthalpy of the outdoor air is less than the enthalpy of the respective indoor space allow the unit to operate in an economizer mode. Start the supply fan at low speed and open the outdoor air damper to provide a 54 degree leaving air temperature. If required to maintain space temperature, increase the supply fan speed and simultaneously modulate open the outdoor air damper to maintain a 54 degree. The unit's barometric relief section will function to maintain a set building differential pressure with relationship to the atmosphere of +0.02" w.c. The DX cooling will not function when the system is in an economizer mode.
  
- J. Occupied heating cycle:
  - 1. Warm-up: provide optimal start through the BMS to index the respective zone to the occupied status. At this time the unit will operate in the same mode as the unoccupied heating cycle. When the space temperature reaches the occupied set point the unit will operate in the occupied cycle.
  - 2. During the occupied cycle the supply fan shall run continuously. Modulate the gas heat to maintain the occupied space temperature.
  
- K. Occupied cooling cycle:
  - 1. Cool-down: provide optimal start through the BMS to index the respective zone to the occupied status. At this time, the unit will operate in the same mode as the unoccupied cooling cycle. When the space temperature reaches the occupied set point the unit will operate in the occupied cooling cycle.
  - 2. During the occupied cycle the supply fan shall run continuously. Modulate the DX cooling to maintain the occupied space temperature.
  - 3. Provide controls for economizer cooling. If the enthalpy of the outdoor air is less than the enthalpy of the respective indoor space allows, the unit to operate in an economizer mode. Start the supply fan at low speed and open the outdoor air damper to provide a 54 degree leaving air temperature. If required to maintain space temperature, increase the supply fan speed and simultaneously modulate open the outdoor air damper to maintain a 54 degree. The unit's barometric relief section will function to maintain a set building differential pressure with relationship to the atmosphere. The DX cooling will not function when the system is in an economizer mode.
  
- L. Ventilation Control: During occupied cycles the outdoor air damper will be open to allow the scheduled amount of ventilation air. The unit's barometric relief section will function to maintain a set building differential pressure with relationship to the atmosphere.
  
- M. Dehumidification sequence:



1. Occupied: At any time the space humidity is above the humidistat set point the supply fan will be on. Energize the DX cooling and the hot gas reheat to maintain the space temperature and humidity set point. When the space humidity level falls below the space sensor set point reverse the sequence.
  2. Unoccupied: If the space humidity is above the humidistat set point start the unit supply fan, energize the DX cooling and hot gas reheat to maintain the space temperature and humidity set point. The outdoor air damper will be closed during unoccupied times.
- N. The BMS monitor, record and display the following points on a custom graphic at the operator work station:
1. System status (occupied/unoccupied): indication and adjustment.
  2. Supply fan status: indication, adjustment and alarm.
  3. VFD status: indication and alarm.
  4. Gas heat status: indication.
  5. DX cooling status: indication.
  6. Hot-gas reheat status: indication.
  7. Unit supply leaving air temperature: indication and adjustment.
  8. Unit return air temperature: indication.
  9. Outdoor air c.f.m.: indication.
  10. Space temperature set point: indication and adjustment.
  11. Space temperature: indication.
  12. Space humidity set point: indication and adjustment.
  13. Space humidity level: indication and alarm.
  14. Smoke detector status: indication and alarm.
  15. MERV 13 filter differential pressure: indication and alarm.
  16. Bipolar ionization status: indication.

### 3.3 CONTROL SEQUENCE RTU-2

- A. The BMS installer is required to review the packaged air handling unit shop drawings prior to submittal of control shop drawings to the Engineer. The BMS installer shall provide all required controls to ensure the units will function as indicated in the following sequence.
- B. The roof mounted packaged air handling unit is a single zone unit and contains a variable speed supply fan, modulating gas heat, barometric relief, filters, air flow monitoring, as well as other components.
- C. The unit shall be controlled by the BMS and shall be indexed to the occupied and unoccupied settings at the fully adjustable programmed times. Provide optimal start/stop programming.
- D. Provide a space thermostat/sensor.
- E. Provide control wiring between the unit starter and a relay furnished by the electrical contractor to allow for fan shut down when the fire alarm system activates. If activated close all outdoor air dampers.
- F. Outdoor air dampers are to fail in the closed position with return dampers failing in the open position.

- G. Provide an analog transducer to monitor and record pressure drop across the MERV 13 filters in the air-handling unit. An alarm will be activated at the BMS workstation if the actual filter pressure drop exceeds the dirty filter pressure drop established by the TAB Contractor.
- H. Unoccupied heating cycle:
1. The supply fan will be off, the outdoor air damper closed and the return air damper open.
  2. When the space temperature falls below the unoccupied set point temperature start the supply fan at full speed and energize the gas heating. When the unoccupied set point temperature has been restored, reverse the above sequence.
- I. Occupied heating cycle:
1. Warm-up: provide optimal start through the BMS to index the respective zone to the occupied status. At this time the unit will operate in the same mode as the unoccupied heating cycle. When the space temperature reaches the occupied set point the unit will operate in the occupied cycle.
  2. During the occupied cycle the supply fan shall run continuously. Modulate the gas heat to maintain the space temperature set point.
  3. Provide controls for economizer cooling. If the enthalpy of the outdoor air is less than the enthalpy of the respective indoor space allows, the unit to operate in an economizer mode. Start the supply fan at low speed and open the outdoor air damper to provide a 54 degrees leaving air temperature. If required to maintain space temperature, increase the supply fan speed and simultaneously modulate open the outdoor air damper to maintain a 54 degree leaving air temperature. The unit's barometric relief will maintain a set space differential pressure with relationship to the atmosphere.
- J. Ventilation Control: During occupied cycles the outdoor air damper will be open to allow the scheduled amount of ventilation air. The unit's barometric relief section will function to maintain a set building differential pressure with relationship to the atmosphere of +0.02" w.c.
- K. The BMS shall monitor, record and display the following points on a custom graphic at the operator work station:
1. System status (occupied/unoccupied): indication and adjustment.
  2. Supply fan status: indication, adjustment and alarm.
  3. VFD status (both fans): indication and alarm.
  4. Gas heat status: indication and adjustment.
  5. Unit leaving air temperature: indication and adjustment.
  6. Unit return air temperature: indication.
  7. Outdoor air c.f.m.: indication.
  8. Space pressurization: indication.
  9. Space temperature set point: indication and adjustment.
  10. Space temperature: indication.
  11. Smoke detector status: indication and alarm.
  12. Freeze stat status: indication and alarm.
  13. MERV 13 filter differential pressure: indication and alarm.
  14. Bipolar ionization status: indication.

**3.4 CONTROL SEQUENCE EXHAUST FANS**

- A. Refer to the drawings for notes to indicate fans that are to be controlled by the BMS.
- B. Provide controls for exhaust fans noted as "Time of Day Schedule" to allow the fan(s) to operate during the occupied cycle of the respective area. De-energize the fan(s) during the unoccupied cycle.
- C. Refer to the contract drawings for exhaust fans that are to be operated with an interlock to other equipment. Where so indicated, provide the required interlock and controls. Provide programming to prevent fan operation when the area is in an unoccupied mode.
- D. Where noted as "Reverse Acting T'stat", provide a reverse acting thermostat in the space to energize the fan when the space temperature is above the set point. De-energize the fan when the space temperature is below set point. If required, provide motorized dampers as well as the required interlock with the fan and damper(s).
- E. Where the drawings indicate a motor operated damper (MOD) is required, provide the damper and control the damper to open when the fan is on and closed when the fan is off.
- F. The BMS shall monitor, record and display the following points on a custom graphic at the operator workstation:
  - 1. Status for all fans: indication and adjustment.
  - 2. Occupied and unoccupied scheduling: indication and adjustment.

**3.5 DOMESTIC HOT WATER SYSTEM RECIRCULATION PUMP**

- A. Provide controls to start and stop all domestic hot water re-circulating water pumps based on a schedule. Provide an alarm to indicate pump failure. The BMS shall monitor, record and display the following points on a custom graphic at the operator workstation:
  - 1. Status of pumps - indication, adjustment and alarm.

END OF SECTION 230905

**SECTION 233110 - 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 metal ducts and accessories for various types of air distribution systems.

**1.3 SUBMITTALS**

- A. Coordination Drawings: Coordination drawings are required. Refer to the applicable Division 1 Specification Section, for the work required by the HVAC Contractor in preparing Coordination Drawings.
- B. Shop Drawings: Provide ductwork shop drawings to indicate the dimensioned locations and elevations of all ducts and duct accessories.
- C. Product data for each of the following products:
  - 1. Duct liner and adhesives.
  - 2. Duct sealants.

**1.4 PERFORMANCE REQUIREMENTS**

- A. 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 as indicated in Part 3 of this specification.
- B. Refer to the contract drawings for any notes that indicate requirements for duct construction that may differ from the SMACNA standard requirements. Where indicated provide duct construction that meets requirements.

**1.5 QUALITY ASSURANCE**

- A. Comply with the requirements of NFPA 90A and 90B.
- B. The installation of all ductwork shall comply with the requirements of the International Mechanical Code and all applicable local codes and code amendments.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect all ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent dirt and moisture from entering ducts and duct fittings. Store ductwork in an area which is protected from the weather. All ductwork shall be shipped with a protective polyethylene film or other water tight covering at the ends of all ducts and fittings. To prevent condensation in the ducts, the covering shall not be added while excessive moisture is present in the duct.
- B. While ducts are stored on-site the protective covering shall remain in place with the ducts stores on skids and placed such that the duct openings are not subject to water infiltration.

PART 2 - PRODUCTS

2.1 SINGLE WALL RECTANGULAR DUCTS AND FITTINGS

- A. Refer to and comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Rectangular Duct Construction," for fabrication of ducts based on the static-pressure class indicated in Part 3 of this specification.
- B. Unless otherwise indicated on the drawings fabricate ducts with a gauge thickness per the requirements of Chapter 2.
- C. Longitudinal Seam, Traverse Joints and Reinforcements: Select and fabricate seam, joint, reinforcement types and sealing requirements and according to the requirements in Chapter 2 for required static-pressure class, applicable sealing requirements, duct-support intervals, and other provisions in the SMACNA Standard."
- D. Duct fittings: fabricate elbows, turning vanes, branch connectors, offsets and transitions in accordance with Chapter 4 of the SMACNA "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Radius elbows: type RE 1 with a center line radius equal to 1.5 times the duct width.
  - 2. Square throat elbows: type RE 2 with turning vanes per figure 4-3 and 4.4.
  - 3. Branch connections: 45 degree entry.

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.
- B. Unless otherwise indicate don the drawings fabricate ducts with a gauge thickness per the requirements of Chapter 3.
- C. Longitudinal Seam, Traverse Joints and Reinforcements: Select seam, joint, reinforcement types and sealing requirements and fabricate according to the requirements in Chapter 3 for required static-pressure class, applicable sealing requirements, duct-support intervals, and other provisions in the SMACNA Standard."
- D. Duct fittings: fabricate elbows and tees in accordance with Chapter 3.

1. Elbows: fabricate with a center line radius equal to 1.5 times the duct diameter.
2. Tees and laterals: fabricate per figure 3-5

### 2.3 SPIRAL SEAM 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.
- B. Unless otherwise indicated on the drawings fabricate ducts with paintable galvanized steel. Duct gauge thickness to be per the requirements of Chapter 3.
- C. Longitudinal Seam shall be a spiral lock seam per figure 3-2 of Chapter 3.
- D. Traverse Joints and Reinforcements: Select seam, joint, reinforcement types and sealing requirements and fabricate according to the requirements in Chapter 3 for required static-pressure class, applicable sealing requirements, duct-support intervals, and other provisions in the SMACNA Standard."
- E. Duct fittings: fabricate elbows and tees in accordance with Chapter 3.
  1. Elbows: fabricate with a center line radius equal to 1.5 times the duct diameter.
  2. Conical tees and laterals: fabricate per figure 3-6.

### 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:
    - a. G60 for interior ducts conveying non-hazardous materials.
    - b. G 90 for interior ducts conveying hazardous materials and all ducts located on the

### 2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with, 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 manufacturers:
    - a. CertainTeed Corporation.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.

2. Materials: ASTM C 1071; surfaces exposed to airstream shall have a factory applied coating to prevent erosion of glass fibers and a factory applied coating on the edge of the liner.
  - a. Thickness: 1 inch or as noted on the drawings.
  - b. Density: 2.0 pcf.
  - c. Thermal performance: "R" equals 4.2 for 1" thick; 6.0 for 1.5" thick; 8.0 for 2" thick.
  - d. Sound Absorption Coefficient (NRC): 0.70 for 1" thick; 0.80 for 1.5" thick; 0.85 for 2" thick.
  - e. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  - f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
  - g. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," and manufacturer's instructions.
3. Where lined ducts are indicated, the duct dimensions indicated on the drawings are the metal size. The net free area size of the duct is the metal size minus the liner thickness.
4. Adhere to a single layer of liner with adhesive coverage per the manufacturer's recommendations.
5. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
6. Butt transverse joints without gaps, and coat joint with adhesive.
7. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
8. Secure liner with mechanical fasteners per SMACNA standards and the manufacturer's recommendations.
9. 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.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.6 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. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.

4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.

## 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," "Rectangular Duct Hangers Minimum Size," - "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Fabricate, install and support ductwork and accessories according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. The installing contractor is required to field verify all duct locations and elevations prior to fabrication of the ductwork.
- C. 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.
- D. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures. Do not locate ducts over electrical panels.
- E. Ship and store all ductwork with a protective closure at the ends of all ducts and fittings. During construction, provide temporary polyethylene film enclosures at all openings in the duct systems, at the time of ductwork installation, to prevent entrance of dust and debris until final connections are completed. Failure to protect duct systems from construction dust and debris will result in the installing contractor being required to Mechanically Clean the affected duct system(s) as indicated in this specification.
- F. Install round and flat-oval ducts in maximum practical lengths.



- G. Install ducts with fewest possible joints. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- H. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- K. Where ducts pass through non-fire-rated interior masonry or drywall partitions and any type of exterior wall(s), 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.
- L. 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. Provide fire-stopping as specified in Section 230500.
- M. Paint interiors of metal ducts that do not have duct liner for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer.
- N. Refer to contract drawings for locations where sprinklers are to be located within various duct systems. Coordinate locations with the sprinkler installer. Refer to contract drawing details for work required for a complete duct installation.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

**3.4 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports and the requirements of the International Mechanical Code Section 603. Support spacing of all hangers shall be per SMACNA standards but in no case shall hangers be spaced at more than 10'-0" intervals.
- B. Supports for Clothes Dryer exhaust ducts shall be at a maximum spacing of 4'-0".
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size," and "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. 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 12 feet.
- E. 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.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Cable Support Systems: Where ducts are exposed to view in finished areas provide cable duct support systems installed per the manufacture's installation instructions.

**3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

**3.6 DUCT CLEANING**

- A. New duct system installations: manually clean ductwork internally, section by section as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

### 3.7 MECHANICAL DUCT CLEANING METHODOLOGY

- A. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
- B. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
- C. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
- D. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
- E. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Provide drainage and cleanup for wash-down procedures.

- G. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 DUCT SCHEDULE

- A. Fabricate ducts with G90 galvanized sheet steel unless otherwise indicated in the following:

- B. Supply Ducts:

- 1. Ducts Connected to the discharge of Air-Handling Units:

- a. Pressure class: positive 2-inch wg.
    - b. Minimum SMACNA seal class: B.

- C. Return Ducts:

- 1. Pressure Class: Positive or negative 2-inch wg.

- a. Interior ducts: minimum SMACNA seal class B.

- D. Exhaust Ducts:

- 1. Pressure Class: Positive or negative 1-inch wg; SMACNA seal class: B if negative pressure, and B if positive pressure.
  - 2. Welding collections systems exhaust duct: minimum 20 gauge galvanized; negative 10" w.g. SMACNA seal class A.

END OF SECTION 233110



**SECTION 233300 - DUCT ACCESSORIES**

**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 various duct accessories such as fire dampers, volume dampers and other items that are typically part of a duct system.

**1.3 SUBMITTALS**

- A. Submit Product Data for all accessories provided on the project.

**1.4 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Where indicated in Part 2, provide products manufactured by the listed companies.

**2.2 SHEET METAL 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.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 or G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

**2.3 MANUAL BALANCING DAMPERS**

- A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Standard Balancing Dampers: Multiple or single-blade, with opposed blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications. Provide single blade dampers where the duct dimension is 10 inches or less in height. Provide dampers with multiple blade design in larger ducts.
  1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; provide frames with flanges where required for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.
  3. Blade Axles: Galvanized steel.
  4. Bearings: Molded synthetic.
  5. Tie Bars and Brackets: Galvanized steel.
- C. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include factory supplied or field installed elevated platform for insulated duct mounting.

## 2.4 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes with the edge of the vanes parallel with the air flow.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch wide, double vane, curved blades of galvanized sheet steel; support with bars perpendicular to blades set 2 inches and set into vane runners suitable for duct mounting.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill and install where noted on the drawings.

## 2.5 DUCT MOUNTED ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include 1-by-1-inch butt or piano hinge and cam latches.
  1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  2. Provide number of hinges and locks as follows:
    - a. Less Than 12 Inches Square: Secure with two sash locks.

- b. Up to 18 Inches Square: Two hinges and two sash locks.
  - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
  - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
  - D. Insulation: 1-inch thick, fibrous-glass or polystyrene-foam board.

## 2.6 FLEXIBLE CONNECTORS

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- C. 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.

## 2.7 FLEXIBLE DUCTS AND ACCESSORIES

- A. Manufacturers:
  - 1. Thermaflex MK-E or equal.
- B. Insulated Flexible Duct: UL 181, Class 1, flexible air duct complying with NFPA Standards 90A and 90B. Flexible duct shall be factory made and composed of a resilient film liner duct liner permanently bonded to a coated spring steel wire helix and supporting a fiberglass insulating blanket. Provide with a low permeability outer vapor barrier of fiberglass reinforced film laminate insulation.
- C. Operating temperatures: -20 Deg. F. minimum; 250 deg. F. maximum.
- D. Operating pressure: 10" w.g. positive; 1" w.g. negative.
- E. Insulation: minimum R 6.0.
- F. Rated velocity 5000 fpm.
- G. Maximum flame spread = 25. Maximum smoke developed = 50.
- H. Flexible Duct Clamps: Nylon strap to suit duct size.
- I. Flexible duct elbow supports: Thermaflex FlexFlow or FlexRight.



2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Ports: 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 the specified external duct insulation thickness. Provide special gaskets where test holes are to be installed in round or oval ducts. Test Ports to be Duro-Dyne model TH1, IP2 and/or IP4.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install manual balancing dampers in ducts with liner utilizing an insulated "hat" section at the damper frame. Avoid damage to and erosion of duct liner. Where balancing dampers are located in ducts with exterior insulation, provide and insulated hat section to house the damper operator.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Provide test holes at fan inlets and outlets and elsewhere as required.
- F. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
  - 1. To interior of ducts for cleaning at maximum 100-foot spacing between access doors.
- G. Install the following sizes for duct-mounting, rectangular access doors:
  - 1. Minimum size 12 x 12 inches. Ducts with one dimension 24" or larger, install a 20" x 20" access door.
- H. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- I. Where indicated on the drawings, connect diffusers to low pressure ducts with maximum 72 inch length of insulated flexible duct. Connect flexible ducts to metal ducts and support flexible ducts in accordance with SMACNA Duct Construction Standards Metal and Flexible, Chapter 3. Install flexible duct elbow supports at all 90 degree flex connections to diffusers.
- J. Install duct test holes where indicated and required for testing and balancing purposes. Coordinate location with testing, adjusting and balancing contractor.

K. Provide turning vanes in all mitered elbows.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

END OF SECTION 233300



**SECTION 233310 - ROOF CURBS, EQUIPMENT SUPPORTS AND ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Roof curbs for duct penetrations.
  - 2. Equipment support curbs for ducts, piping and equipment.
  - 3. Piping roof penetration systems.

**1.3 SUBMITTALS**

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

**1.4 QUALITY ASSURANCE**

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

**1.6 PROJECT CONDITIONS**

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

**1.7 COORDINATION**

- A. Coordinate layout and installation of roof accessories with roofing system to provide a weather-tight, secure, and non-corrosive installation.

PART 2 - PRODUCTS

2.1 ROOF CURBS

- A. Provide roof curbs for duct penetrations through the roof: prefabricated galvanized steel roof curbs fabricated from minimum 16 gauge steel with welded corners. Curbs to be internally reinforced, factory insulated with 1.5" thick 3 lb. density fiberboard insulation. Where required provide curbs with wood nailers.
1. Manufacturers:
    - a. Custom Curb, Inc.
    - b. Pate Company (The).
    - c. Roof Products & Systems Corporation.
    - d. Roof Products, Inc.
  2. Refer to drawing details for the type of curb required for the specified roofing system. Furnish curbs with an integral metal cant, stepped integral metal cant raised the thickness of roof insulation or no integral cant, as required to suit the details. Provide curbs to meet the installed curb height as detailed on the drawings. Fabricate roof curbs to match the roof slope so that the top of the curb is level.
- B. Accessories: In addition to a roof curb, provide the following for all piping penetrations through the roof:
1. Pipe portal curb cover furnished with a laminated acrylic coated ABS plastic curb cover with pre-punched holes and molded sealing ring on a collared opening, and an EPDM compression molded cap with stainless steel snap lock clamps. Curbs covers shall be resistant to ozone and ultraviolet rays and shall have a serviceable temperature range of -40 degrees F to positive 250 degrees F. The molded sealing ring on the collared opening and the groove in the rubber cap shall be installed to assure a weather-tight pressure and mechanical seal. The protective rubber caps shall have a serviceable temperature range of -60 degrees F to positive 250 degrees F and shall be resistant to ozone and ultraviolet rays. The conical shaped steps of the nipple shall provide a weatherproof seal around the penetration. The stainless steel snap lock clamps shall provide added protection to guarantee the seal.

2.2 EQUIPMENT/DUCT SUPPORTS CURBS

- A. Provide prefabricated equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate from minimum 18 gauge galvanized steel with all welded construction. Provide factory installed wood nailer base plate and counter flashing.
- B. Refer to drawing details for the type of curb required for the specified roofing system. Furnish curbs with an integral metal cant, stepped integral metal cant raised the thickness of roof insulation or no integral cant, as required to suit the details. Furnish curbs to meet the installed curb height as detailed on the drawings. Fabricate roof support curbs to match the roof slope so that the top of the curb is level.
1. Manufacturers:

- a. Thybar.
- b. Custom Curb, Inc.
- c. Pate Company (The).
- d. Roof Products & Systems Corporation.

### 2.3 PIPE PORTAL CURBS

- A. Provide pre-manufactured Pipe Portal flashing systems as manufactured by Roof Products & Systems, or equal, at all roof penetrations for piping. Each Pipe Portal flashing system shall include an RPS pre-manufactured roof curb, flashing system cover(s), and molded EPDM rubber cap(s) with stainless steel clamp(s). EPDM rubber shall have a serviceable temperature range of -60°F to +270°F and be resistant to ozone and ultraviolet rays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions to verify actual locations, dimensions, and other conditions affecting performance of work. Verify dimensions and locations of roof openings for roof accessories. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Roof curbs: furnish and install a roof curb for all duct and piping penetrations. Install the ductwork and / or piping through the roof curb immediately after the curb is installed, providing a water tight installation. If immediate installation is not performed provide temporary watertight covering, for all curb openings, consisting of minimum ¾" exterior grade plywood and watertight rubber or plastic cover.
- B. Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- C. Install roof accessories to fit substrates and to result in watertight performance.
- D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- E. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

END OF SECTION 233310



**SECTION 233400 - FANS**

**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 various types of fans and accessories. Refer to the drawings plans and schedules and provide all required options and accessories.

**1.3 SUBMITTALS**

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material gages and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For power ventilators to include in maintenance manuals specified in Division 1.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain all similar types of fans from one source and from a single manufacturer, regularly engaged in production of exhaust fans.
- 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.



- E. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.7 WARRANTY

- A. All equipment, material and labor provided under this specification section shall be warranted for a period of one year from the date of substantial completion.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL DOWNBLAST ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide roof ventilators manufactured by Loren Cook model ACE-B and / or ACE-D. Subject to review, equipment meeting the full requirements of the specifications, manufactured by the following will be considered:
  - 1. Carnes Corp.
  - 2. Greenheck.
  - 3. Penn Barry.
  - 4. Solar & Palau, USA.
  - 5. CaptiveAire
- B. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle with square aluminum base and venturi cone inlet for exhaust applications; and die formed louvered aluminum inlet panels in rectangular configuration with square base and rectangular outlet for makeup applications.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
  - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from airstream on exhaust fans.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent on direct drive units.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, ½-inch mesh, aluminum or brass wire.
4. Dampers: parallel-blade, backdraft dampers mounted in curb base on exhaust fans; factory set to close when fan stops.

## 2.2 CENTRIFUGAL UPBLAST ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide roof ventilators manufactured by Loren Cook model ACRU-D. Subject to review, equipment meeting the full requirements of the specifications, manufactured by the following will be considered:

1. Carnes Corp.
2. Greenheck.
3. Penn Barry.
4. Solar & Palau, USA.
5. CaptiveAire

B. Provide roof mounted spun aluminum, direct drive, up-blast centrifugal exhaust ventilator. Refer to contract drawings for specific fan models and accessories. Fan(s) shall be listed by Underwriters Laboratories per UL 762 and shall bear the AMCA certified ratings seal for sound and air performance.

C. Fan wheels shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 20405, Balance Quality and Vibration Levels for Fans.

D. Construction, Direct Drive units: fan(s) shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment with integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging.

E. Direct Drive Fan Motors:

1. EC Motors: Motor shall be an electronically commutated motor rated for continuous duty and furnished either with leads for connection to 0-10 VDC external controller.

2. Non-EC Motors: Motor shall be NEMA design B with a minimum of class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure
3. NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

F. Accessories:

1. AMCA A spark-resistant construction.
2. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent on direct drive units.
3. Disconnect Switch: explosion proof with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
4. Bird Screens: Removable, ½-inch mesh, aluminum or brass wire.
5. Dampers: parallel-blade, backdraft dampers mounted in curb base on exhaust fans; factory set to close when fan stops.

2.3 INLINE FANS

A. Manufacturers: Subject to compliance with requirements, provide ceiling mounted fans manufactured by Loren Cook, model GN 1000 / 2000. Subject to review, equipment meeting the full requirements of the specifications manufactured by the following will be considered:

1. Carnes Corp.
2. Greenheck.
3. Penn Barry.
4. Solar & Palau, USA.
5. CaptiveAire

B. Description: Fan shall be inline mounted, direct driven, centrifugal exhaust fan.

C. Construction: The fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel. Motor shall be resiliently mounted. Unit shall be supplied with integral wiring box. Discharge position shall be field convertible from straight through, inline configuration to right angle configuration by moving interchangeable panels. The outlet duct collar shall include reinforced aluminum dampers with continuous aluminum hinge rods and brass bushings.

D. Fan Wheel: Wheels shall be twin DWDI centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

E. Motor: Motor shall be totally enclosed type with permanently lubricated bearings and built-in thermal overload protection. Motor shall be furnished at the specified voltage and phase.

F. Accessories: Provide accessories noted on the drawings.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

## 2.5 ROOF CURBS

- A. Provide insulated metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- B. Refer to drawings for the type of curb required for the specified roofing system and the required curb height. Provide curbs with an integral metal cant, stepped integral metal cant raised the thickness of roof insulation or as required to suit the details.
- C. Provide curbs to match the roof slope. Refer to contract drawings to verify roof slope.
- D. Curb Material: Galvanized sheet, minimum 16 Gauge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Install units with clearances for service and maintenance.
- E. Roof curbs: furnish and install a roof curb for all roof mounted fans. Install the roof mounted unit(s) on the roof curb immediately after the curb is installed. If immediate installation is not performed provide temporary watertight covering, for all curb openings, consisting of minimum 3/4" exterior grade plywood and watertight rubber or plastic cover.

### 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.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment.

**3.3 FIELD QUALITY CONTROL**

- A. Equipment Startup Checks: Perform startup per Manufacturer's Instructions on all fans. Verify that unit is secure on mountings and supporting devices and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
- B. Verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
- C. Verify lubrication for bearings and other moving parts.
- D. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
- E. Starting Procedures: Energize motor and adjust fan to indicated rpm and measure and record motor voltage and amperage.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Shut unit down and reconnect automatic temperature-control operators.
- I. Replace fan and motor pulleys as required to achieve design airflow.
- J. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- K. The installing contractor shall provide a completed written startup report that records results of all tests and inspections and verifies all fans, associated controls and wiring are installed properly. The start-up report shall be forwarded to the owner's representative.

**3.4 ADJUSTING**

- A. Adjust damper linkages for proper damper operation and adjust belt tension where required..

**3.5 CLEANING**

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

**3.6 DEMONSTRATION**

- A. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 233400

**SECTION 233710 - DIFFUSERS, REGISTERS, AND GRILLES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes ceiling and wall mounted diffusers, registers, grilles and accessories.

**1.3 DEFINITIONS**

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

**1.4 SUBMITTALS**

- A. Submit manufacturer's technical product data for all air outlets. For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished. The schedule shall also indicate static-pressure drop, and noise criteria ratings (NC) for each air outlet and inlet. A generic catalog sheet indicating pressure drop and NC ratings is not acceptable.

**1.5 QUALITY ASSURANCE**

- A. Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems.
- B. Source Limitations: Obtain diffusers, grilles and registers through one source from a single manufacturer, regularly engaged in production of the equipment.

**PART 2 - PRODUCTS**

**2.1 LOUVERED FACE CEILING AIR DIFFUSERS**

- A. General: Provide louvered face ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide diffusers manufactured by Titus. Subject to review, diffusers meeting the full requirements of the specifications and manufactured by one of the following will be considered:
  - 1. Krueger
  - 2. Price Industries.
  - 3. Nailor.
  - 4. Anemostat.
  - 5. Metalaire.
- B. Ceiling diffusers shall have a fixed or adjustable horizontal discharge pattern. The inner louver assembly shall be flush with the outer frame with a 1, 2, 3 or 4-way directional pattern. Individual louvers shall have a horizontal lip to create a ceiling pattern at reduced air flows. The inner core must be easily removable.
- C. Ceiling Compatibility: Provide louvered diffusers with border styles that are compatible with adjacent ceiling systems. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: The model numbers and manufacturers indicated on the diffuser schedule set the standard for the products to be used. Provide louvered diffusers of type as scheduled and with accessories as required.
- E. Provide each diffuser in the manufacturer's standard white electro-coated finish unless otherwise indicated on the drawings.
- F. Diffusers shall be provided with the same style and characteristics as provided with the basis of design product named on the drawings.

**2.2 REGISTERS AND GRILLES**

- A. General: Provide registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide opposed blade damper on all registers. Provide registers and grilles manufactured by Titus. Subject to review, diffusers meeting the full requirements of the specifications and manufactured by one of the following will be considered:
  - 1. Krueger
  - 2. Price Industries.
  - 3. Nailor.
  - 4. Anemostat.
  - 5. Metalaire.

- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Structural Integrity: floor registers and grilles are required to meet the structural requirements indicated in the International Mechanical Code Chapter 6: 603.18.1.
- D. Compatibility: Provide registers and grilles with border styles indicated and that are compatible with adjacent wall or ceiling systems, and that are specifically manufactured to fit into construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of construction which will contain each type of register and grille.
- E. Types: The model numbers and manufacturers indicated on the drawing schedules set the standard for the product(s) to be provided. Provide registers and grilles of type as scheduled, with accessories as required to match the basis of design product named on the drawing.
- F. Provide each register and/or grille in manufacturer's standard white electro-coated finish. Refer to equipment schedules for grilles/registers that require a custom color. When required, the Architect will select the custom colors.

### 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. 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 practicable. 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. Provide any fasteners (screws, tamper proof screws, etc.) that are required by the manufacturer for installation.

#### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.



3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233710

**SECTION 233730 - LOUVERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Fixed Extruded Aluminum Stationary Louvers with Wind Driven Rain Certified Horizontal Blades.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on a uniform pressure of 30 lb / sq. ft., acting inward or outward.
- B. 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.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product including manufacturer's data with appropriate AMCA Certified Ratings Seals.
- B. Provide shop drawings including plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
- C. Provide samples for initial selection.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Product must be licensed to bear the AMCA Certified Ratings Seal for Water, Air, and Wind Performance.
- C. Louvers shall be warranted against manufacturing defects for a period of 5 years.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 FIXED BLADE EXTRUDED-ALUMINUM LOUVERS

- A. Manufacturers: Provide Model ECD-635 Louvers manufactured by Pottorff. Subject to compliance with requirements products manufactured by one of the following may be considered:
  - 1. Dowco.
  - 2. Greenheck
  - 3. Louvers & Dampers, Inc.
  - 4. Metalaire.
  - 5. Nailor
  - 6. Ruskin Manufacturing.
- B. Construction:
  - 1. Material: Mill Finish 6063-T5 extruded aluminum.
  - 2. Frame: 6" deep x 0.081" thick channel.
  - 3. Blades: 35° x 0.081" (2) thick horizontal drainable chevron style.
  - 4. Screen: ½" x 0.063" (12.7 x 1.6) expanded and flattened aluminum mesh insect screen.
  - 5. Mullion: Visible.
- C. Performance Data: free area and pressure drop as indicated on the drawing schedules.
  - 1. Maximum Pressure Drop as indicated on the drawing schedules.
  - 2. Maximum Water Penetration: 0.01 ounces per square foot of free area at an air flow of 1,217 fpm free area velocity when tested for 15 minutes.
  - 3. Minimum wind driven rain performance @ 8 in/hr rainfall rate and 50 mph wind speed based on testing 39.375 inch x 39.375 inch core area louver:
    - a. Core Velocity: 441 fpm (2.24m/s)
    - b. Effectiveness Ratio: 96.6%
    - c. Wind Class: B
    - d. Discharge Class: 2

- D. Design Load:
  - 1. Wind Load: Louver designs shall withstand the effects of 30 psf (1.44 kPa) of uniform pressure acting inward or outward.
  - 2. Seismic Performance: Louvers, including attachments to other construction, shall withstand seismic effects determined by ASCE-7.
  
- E. Louver(s) Finish:
  - 1. High Performance Fluoropolymer: Complying with AAMA 2605 and containing not less than 100 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.
  - 2. Color and Gloss: Provide louvers with finished color and gloss as selected by the Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.3 INSTALLATION

- A. Install louvers at locations as indicated on the drawings and in accordance with manufacturer's instructions. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted 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 or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- G. Install concealed gaskets, flashings and joint fillers as louver installation progresses. Provide a weathertight louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 233730

**SECTION 233920 – WELDING SMOKE COLLECTION SYSTEM**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes welding smoke collection equipment and accessories. Refer to the drawings plans and schedules and provide all required equipment, options and accessories.

**1.3 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Include plans and elevations of the equipment. Provide information on all accessories including a wiring diagram for power and control wiring. Provide Operation and Maintenance Data.

**1.4 WARRANTIES**

- A. Provide a full one year warranty on the collectors including parts and labor.

**PART 2 - PRODUCTS**

**2.1 WELDING SMOKE COLLECTOR**

- A. Provide a welding smoke collector manufactured by Airex. Refer to the drawing schedules for specific model number, duties and electrical characteristics.
- B. Furnish and install, where shown on the plans, a high efficiency cartridge filter type collector with integral blower. The collector shall be a self-cleaning vertical cartridge type complete with filters, backward inclined blower and interconnecting duct with external silencer. Collector construction shall be minimum 12 gauge modular welded steel construction with steel frame and tube sheet. The collector to consist of a single filter module with (1) hopper.

- C. Collectors to include (30) 315 sq. ft. cartridge type filters manufactured from Nanofiber with a Class 2 fire retardant coating. Cartridges to have an efficiency of 99.999% at 0.5 micron. Air to cloth ratio shall not exceed 1.86 to 1. Horizontal / Semi horizontal filter configuration dust collectors not acceptable. Cartridge filters shall be accessed thru quick opening access doors. No tools shall be required for removal of cartridges. Doors shall be heavy duty formed steel with mechanically attached seal.
- D. Collector shall be provided with an integrated timer and motor controller in a NEMA 12 enclosure for field installation inside the shop area as designated on the drawings. Included shall be IEC solid state fused disconnect switch for overload protection, start/stop/reset buttons, LED run indication, transformer for 120/1/60 VAC control voltage, digital pulse timer controller, on demand and continuous cleaning options via digital gauge (0" to 20" WG) and main rotary disconnect and fuse block sized to match horsepower. Motor starter shall be variable frequency drive and allow for setting interface of 30%, 40%, 70% and 100%. This shall be factory programmed by the collector manufacturer. The switches for this shall be located on the control panel. The switch will also send a signal to the air operated control gate (120V) in the duct to the downdraft plasma table to "open or close" the damper and to reduce or increase airflow. Plastic tubing line sets to be ran from the digital controller to taps on the collector by HVAC contractor. HVAC contractor to provide all required control wiring needed for the damper and solenoids on the collector.
- E. The collector shall be provided with a 60 HP, 460/3/60 belt drive non-overloading backward inclined exhaust fan, mounted on the ground beside the collector. Blower shall be a Class 3 AMCA C construction and to include unitary base and manual outlet damper. Motor shall be TEFC type and shall include all belts and OSHA belt guard. AEGIS Shaft Grounding Rings shall also be provided to protect the motor from VFD induced shaft voltages. Inter-connecting duct from the blower inlet to the collector outlet, minimum 12 gauge metal shall also be provided by the collector manufacturer. Blower and inter-connecting duct shall be painted to match the collector. Blower shall be rated for 17,600 cfm @ 14" TSP.
- F. Electrical contractor to provide electrical safety disconnect at the blower, refer to electrical drawings.
- G. Collector shall be provided with an external discharge silencer 36" x 48" x 72" long with transition to match blower outlet, painted to match the collector.
- H. Collector shall include a reverse pulse cleaning system with beveled nozzle. Included are blow pipes, internal piping, compressed air header, solenoid valves and diaphragm valves. The diaphragm valves shall be a minimum 1-1/2" diameter.
- I. Provide the collector with (1) drum cover, flex hose, clamps and 45 gallon drum for storage. Drum painted to match the collector.
- J. The collector shall be provided with inlet duct connection – square to round transition within hopper at low entry point with rectangular baffle.
- K. The collector shall be painted with 1 coat of primer and 2 coats of polyurethane for minimum 3 mil thickness. All carbon steel components shall be acid washed prior to painting. Unit shall be painted Airex Gray color.
- L. Collectors to have 3/4" standard NPT coupling for compressed air.

- M. The collector to be provided with a remote mounted point of use desiccant air dryer and coalescer, complete with regulator, gauge and moisture indicator. The air dryers to be field installed by the compressed air piping contractor.
- N. The collector shall be provided with (1) 10" diameter air operated pneumatic damper with interlock controls for the duct line feeding to the downdraft plasma table as noted on the drawings. Damper shall be controlled via electrical signal from the collector control panel. Electrical control wiring from the control panel to the damper shall be by the HVAC contractor. A ¼" airline to be connected to damper shall be provided by HVAC contractor.

## 2.2 DOWNDRAFT TABLE

- A. Provide a Downdraft Table manufactured by Airex. The table to be 60" x 30", without filters, for use at a hand held plasma cutting station. The table to be manufactured from 12 gauge carbon steel and to be of welded construction. Table to include 16 gauge steel side and back walls, steel grate top, forklift pockets, baffled inlet and removable dust drawer. Table to be painted to match collector.

## 2.3 FUME EXTRACTORS

- A. Provide fume extractor arms manufactured by Henlex, model V6-A-05-2R-NC-CV-JO-WB. Arms to be 6" x 5' and to include the following;
  - 1. Arm assembly to be constructed with (2) cast aluminum friction joints. Friction joint tension is adjustable by using external handle to compress a compression spring on a thrust bearing.
  - 2. Arm assembly to include source capture hood with 360 degree rotating ball joint type joint and handle.
  - 3. Source capture arm to include butterfly damper
  - 4. Source capture arm to include wall mounting bracket. Wall mounting bracket to be equipped with a dielectric union to insulate the arm from ground to prevent welding on the arm
  - 5. Source capture arm to be constructed from 6" aluminum tube, .100" thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install collectors and accessories according to manufacturer's installation instructions. Provide all required duct connections as detailed on the drawings.
- B. Verify all electrical connections are complete before starting units.
- C. Provide all required controls including wiring to have a fully complete and function system.
- D. Coordinate the location and size requirements of the concrete pad foundation which is supplied by others.



3.2 START-UP AND FIELD QUALITY CONTROL

- A. Prior to start-up, clean units to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and all internal components.
- B. Start-up service shall be provided by the equipment manufacturer's authorized representative and shall include complete testing of all controls and unit operation. The agency responsible for start-up shall record all operating data. Copies of this data are to be supplied to the owner. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 233920

**SECTION 233950 – INDUSTRIAL VENTILATION EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes various types of industrial ventilation equipment and accessories.

**1.3 SUBMITTALS**

- A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for unit.
- B. Provide Operation and Maintenance Data.

**1.4 WARRANTIES**

- A. Provide a full one year warranty on the equipment including parts and labor.

**PART 2 - PRODUCTS**

**2.1 AMBIENT AIR CLEANERS**

- A. Manufacturer: Subject to compliance with requirements, provide Ambient Air Cleaners manufactured by Industrial Maid LLC. Refer to the drawing schedules for specific model numbers.
- B. Air filtration units shall be two stage self-contained disposable media air cleaners to remove contaminants of smoke and dust. Filters shall meet or exceed ASHRAE standard 52-76 test methods. Electrostatic type units will not be accepted.
- C. Units shall be self-supporting for wall or ceiling mounting. Cabinet shall be 16 gauge welded zinc grip steel with a two part urethane coating and a hinged final filter access door.
- D. The cabinet construction to be 14 gauge welded steel frame with 3/16" polyethylene panels.

- E. Blower Assembly: Provide a belt drive forward curve with a 2 hp 460/3/60 TEFC motor. Motor to be factory wired to junction box mounted to side of air cleaner. Electrical disconnect furnished and installed by others.
- F. The ambient cleaners to have a straight thru air flow design with side discharge.
- G. Pre-filters: Provide washable 4" galvanized spark baffle pre-filters
- H. Provide MERV 15 multi-pocket disposable bag filters. The filters to have a minimum of 80 square feet of area per filter.
- I. Provide one complete set of filters for initial installation and one complete additional set of filters.
- J. Unit to include a 0" to 5" factory mounted magnahelic filter change gauge.
- K. Provide a discharge silencer with 4-way adjustable outlet grille.
- L. Cleaners to have Delta variable frequency drives with on/off control buttons. Drives to be factory programmed to power the motor and control motor speed based on filter loading. Drives to ship loose from air cleaners and to be field mounted and wired by Electrical contractor.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install ventilation equipment per the Manufacturer's instructions.
- B. Verify all electrical connections are complete before starting units.
- C. Provide all required controls including wiring to have fully complete and function systems.

#### 3.2 START-UP AND FIELD QUALITY CONTROL

- A. Start-up service shall be provided by the equipment manufacturer's authorized representative and shall include complete testing of all controls and unit operation. The agency responsible for start-up shall record all operating data. Copies of this data are to be supplied to the owner. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 233950

**SECTION 234110 - AIR PURIFICATION SYSTEM**

**PART 1 – GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. This section describes the design, performance and installation of an ionization air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

**1.2 REFERENCED CODES & STANDARDS**

- A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867 including ozone chamber test

**1.3 QUALITY ASSURANCE**

- A. The Air Purification System shall be a product of an established manufacturer in the USA and shall be manufactured and assembled in the USA.
- B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendations.
- C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
- D. The Air Purification Technology shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. All manufacturers shall submit their independent UL 867 test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

**1.4 SUBMITTALS**

- A. Submit manufacturer's technical product data for ion generators including:
  1. Schedule of plasma generators indicating model number and quantity of each type required for each unit/application.
  2. Submittal sheet for each type of plasma generator and accessories furnished; indicating construction, dimensions, electrical data, and mounting details.

3. Product drawings detailing all physical, electrical and control requirements.
4. Copy of UL 867 independent ozone test.

B. Operating & Maintenance Data: Submit O&M data and recommended spare parts list.

#### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of products shall be in factory fabricated shipping cartons. Identify on outside of carton the type of product contained within. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

#### 1.6 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

### PART 2 – PRODUCTS

#### 2.1 GENERAL

- A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the furnished equipment and shall be manufactured by Plasma Air International ([www.plasma-air.com](http://www.plasma-air.com)). Equal systems manufactured by Global Plasma Solutions, AtmosAir and Top Product Innovations are acceptable.

#### 2.2 BI-POLAR IONIZATION DESIGN AND PERFORMANCE CRITERIA

- A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.
- B. The Bi-polar Ionization system shall be capable of:
  1. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
  2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
  3. Reducing space static charges.
  4. Reducing space particle counts.
  5. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth.
  6. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:

- a) MRSA: 99.5% in 60 minutes or less
  - b) E. Coli: 93.5% in 30 minutes or less
  - c) H1N1: 86.6% in 60 minutes or less
  - d) Aspergillus: 74.8% in 60 minutes or less
- C. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.
- 1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to the air purification system requirements.
  - 2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions to the air purification system.
- E. Ionization Equipment Requirements:
- 1. Electrode Specifications (Bi-polar Ionization):
    - a. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
    - b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
    - c. Ionization output when tested in the occupied space shall be between 500 and 800 ions/cm<sup>3</sup>.
    - d. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air stream will not be accepted.
  - 2. Small Capacity Air Handling Units, Fan Coils, and Unit Ventilators:
    - a. Ion generators for small capacity air handling units, fan coils units, and unit ventilators shall be brush type needlepoint units similar to Plasma Air model PA660 designed to be mounted at the fan inlet.
    - b. The unit shall be rated to treat up to 2,400 CFM per module. For airflows greater than 2,400 CFM, up to 3 module units shall be utilized.
    - c. The PA660 housing is made from ABS plastic, contains an LED ionization output indicating LED, and an in-line 1 Amp fuse.
    - d. The unit shall be capable of directly accepting voltage of 12V DC or 24V AC. The panel shall have an on/off switch, ionizer indicator LED, and a set of dry contacts which will feedback ionizer functionality. Dry contacts that indicate power available only shall not be acceptable.
    - e. For systems that do not include a feedback electronic signal indicating ion production, provide an ion sensor powered from 12V DC or 24V AC. Ion sensor to be user adjustable from 500 to 20,000 ions per cm<sup>3</sup> and contain a dry contact BMS interface. To be clear, for systems that only indicate power available to the ionizer, vendor must provide duct mounted ion sensor described herein.
    - f. The unit shall contain two (2) mounting feet and shall be configured so the needles are oriented perpendicular to the flow of air entering the fan wheel.

3. Certifications:

- a. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners. UL listings for standards other than 867 will not be acceptable.
- b. The operation of the electrodes or bipolar ionization units shall conform to UL 867 with respect to ozone generation.

F. Electrical Requirements:

1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
2. Wiring, conduit and junction boxes shall be furnished and installed by the HVAC controls sub-contractor within housing plenums and shall be UL and NEC NFPA 70 approved.
3. Furnish and install control relay to operate the ionizer when the supply fan is energized.

G. Control Requirements:

1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
2. All plasma ion generators shall include an external BMS interface to indicate ion generator status and alarm.

H. Monitoring Devices:

1. Provide to the owner a portable hand held ion counter with a calibrated range of 0 to 20,000 ions/cm<sup>3</sup> and an accuracy of +/- 25% within the specified range. Ion counter shall have automatic zeroing capability on 10 minute intervals.

**PART 3 – EXECUTION**

**3.1 GENERAL**

- A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

**3.2 ASSEMBLY & INSTALLATION: PLASMA GENERATOR WITH BI-POLAR IONIZATION**

- A. All equipment shall be assembled and installed with a high level of workmanship to the satisfaction of the owner, architect and engineer.
- B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the owner.
- C. All equipment shall be protected from damage on a daily basis throughout construction.
- D. Install unit at fan inlet or in fan section per manufacture's recommendations.

- E. Provide all wiring through control relay to ionizer unit to allow unit to operate when supply fan is energized.

**3.3 COMMISSIONING & TRAINING**

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 234110





**SECTION 237510 - PACKAGED OUTDOOR AIR-HANDLING UNITS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes packaged outdoor units and accessories.

**1.3 SUBMITTALS**

- A. Prior to submission of the specified equipment, the Outdoor Air Handling Unit supplier is required to submit shop drawings to the BMS Installer for coordination purposes. The Outdoor Air Handling Unit Supplier will incorporate any comments from the BMS installer then submit the air handling unit shop drawings for review to the Engineer and note the BMS installer has reviewed the equipment submittal(s). If this requirement is not performed the equipment shop drawings will not be reviewed.
- B. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Source Limitations: Obtain all Packaged Outdoor Units from a single manufacturer, regularly engaged in production of the required components.

1.5 WARRANTY

- A. Provide a written warranty in which the contractor agrees to repair or replace any unit component that fails for a period of one year from the date of Substantial Completion.
- B. In addition to the above, the unit manufacturer shall provide the following warranties:
  - 1. A 5 year warranty for the unit compressors. The warranty period will begin at the date of shipment and will not include labor.
  - 2. A 5 year warranty for gas furnace heat exchangers: The warranty period will begin at the date of shipment and will include materials and labor.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: Two sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide units manufactured by Aeon, Inc. Units manufactured by others may be considered if approved prior to bidding.
- B. Subject to review, air handling units meeting the full requirements of the specifications and manufactured by one of the following will be considered:
  - 1. Trane
  - 2. Daiken.

2.2 DESCRIPTION

- A. Refer to the following specifications and the contract drawings for all options and accessories required for all units.
- B. Unit shall be factory assembled and tested including leak testing of the 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 controls compartment's literature pocket.

2.3 CONSTRUCTION

- A. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels. 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.

- B. Unit shall be constructed with double wall G90 galvanized steel on both sides with a thermal break and no metal path from inside to outside the cabinet. 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. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
- C. Access to filters, dampers, cooling coils, reheat coil, heaters, supply fans, exhaust fans, return fans, energy recovery wheels, compressors, water-cooled condensers, 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.
- D. 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.
- E. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
- F. 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.

#### 2.4 FANS

- A. Supply Fans: Provide shall include direct drive, un-housed, backward curved, plenum supply fans. Blowers and motors shall be dynamically balanced and mounted on rubber isolators. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points. Where indicated, provide variable frequency drives that are factory wired and mounted in the unit.

#### 2.5 COOLING COILS

- A. Evaporator Coils: Coils shall be designed for use with R-410A 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. Coils shall have interlaced circuitry and shall be 6 row high capacity. Coils shall be helium leak tested. Coils shall be furnished with a factory installed thermostatic expansion valves.

#### 2.6 REFRIGERATION SYSTEM

- A. Unit shall be factory charged with R-410A refrigerant. Compressors shall be scroll type with thermal overload protection and independently circuited. 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 insulated panels to prevent the transmission of noise outside the cabinet. 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. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control. 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 factory installed liquid line filter driers. Unit shall include 2 stages of capacity control.

- B. All units shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification 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 the unit(s) is to be furnished with a single compressor the compressor shall be a variable capacity scroll compressor.

## 2.7 AIR-COOLED CONDENSER

- A. The Condenser fans shall be vertical discharge, axial flow, direct drive fans. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Coils shall be designed for a minimum of 10 degree F of refrigerant sub-cooling. Coils shall be helium leak tested.

## 2.8 GAS HEATING

- A. Where indicated provide units with modulating natural gas heating.
- B. Provide a stainless steel heat exchanger for the gas furnace which shall carry a 25 year non-prorated warranty. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required. Unit shall be able to operate with a minimum of 6" w.c. and a maximum of 10" w.c. gas pressure.
- C. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.
- D. Gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature set point shall be adjustable on the electronic controller within the controls compartment. 195 MBtu/h gas heating assembly shall be capable of operating at any firing rate between 100% and 30% of their rated capacity. 405 MBtu/h gas heating assembly shall be capable of operating at any firing rate between 100% and 20% of their rated capacity. Furnace to be capable on operating at a minimum gas pressure of 6" w.c. and 10" w.c. maximum.

2.9 FILTERS

- A. Refer to the contract drawings for filter requirements.
  - 1. Pre-filters: provide MERV 8 pleated media filters.
  - 2. Final Filters: provide MERV 13 pleated filters with optional clogged filter switch.

2.10 OUTDOOR AIR

- A. Units shall have a 0-100% economizer consisting of a motor operated outdoor air damper and return 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" w.g. air pressure differential across the damper. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure. Barometric relief damper shall be provided as part of the economizer option. Economizer shall be furnished with return air CO<sub>2</sub> override option where CO<sub>2</sub> control is specified.

2.11 VARIABLE FREQUENCY DRIVES (VFD)

- A. Provide variable frequency drives supply fans furnished by the unit manufacturer.
- B. Unless otherwise indicated on the drawings variable frequency drives shall be mounted and wired by the AHU manufacturer. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFDs shall be UL listed. The listing shall allow mounting in plenum or other air handling compartments.
- C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor de-rating.
- D. With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- E. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- F. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL 508 certified for the building and assembly of option panels. Assembly of separate panels with options by a third-party is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel.
- G. The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

- H. The VFDs full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- I. The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.
- J. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- K. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- L. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
- M. Galvanic and/or optical isolation shall be provided between the VFDs power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- N. The VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- O. Protective Features:
  - 1. Protection shall be provided against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults as words. Codes are not acceptable.
  - 2. The VFD shall be protected from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD shall continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.
  - 3. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
  - 4. The VFD package shall include semi-conductor rated input fuses to protect power components.
  - 5. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the AHU manufacturer shall ensure that inverter rated motors are supplied.
  - 6. The VFD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
  - 7. The VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
  - 8. The VFD shall catch a rotating motor operating forward or reverse up to full speed.

9. The VFD shall be rated for 65,000 amp interrupting capacity (AIC).
10. The VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD shall identify which of the output phases is low or lost.
11. The VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt units, 539 V AC on 460 volt units, and 690 volts on 600 volt units.
12. Shaft grounding rings shall be incorporated into motors 10HP and higher to prevent electrically induced bearing damage when VFDs are utilized on larger pump and fan motors. Coordinate work with drive and equipment manufacturers.

#### 2.12 AIR FLOW MONITORS

- A. Provide airflow measurement system for monitoring and controlling minimum outdoor airflow rate. The monitoring equipment shall measure outside air as required and provide input to building management system with a linear measured airflow rate.
- B. The monitoring equipment shall be tested in accordance with AMCA 610, Figure 4, Methods of Testing Airflow Measurement Stations for Rating, and AMCA 611, Certified Ratings Program - Airflow Measurement Performance, in an AMCA-registered testing facility and bear the AMCA International Certified Ratings Seal for Airflow-Measurement Station Performance.

#### 2.13 ELECTRICAL POWER CONNECTION

- A. Unit shall be provided with power block for connecting power to the unit.
- B. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
- C. Unit shall be provided with factory installed and factory wired 115V, 13 amp GFI outlet with outlet disconnect switch in the unit control panel.

#### 2.14 ROOF CURBS

- A. Refer to drawings for the type of curb required for the specified roofing system and the required curb height. Furnish curbs with an integral metal cant, stepped integral metal cant raised the thickness of roof insulation or as required to suit the details.
- B. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.

### PART 3 - EXECUTION

#### 3.1 SHIPPING

- A. Protect equipment during shipment and delivery, all units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment.



**3.2 ON-SITE STORAGE**

- A. If equipment is to be stored for a period of time prior to installation, the installing contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in an area not subject to rain and/or snow.

**3.3 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.4 INSTALLATION**

- A. Roof curb: provide a roof curb for all roof mounted units. Install the roof mounted air handling unit(s) on the roof curb immediately after the curb is installed. If immediate installation is not performed provide temporary watertight covering, for all curb openings, consisting of minimum  $\frac{3}{4}$ " exterior grade plywood and watertight rubber or plastic cover.
- B. When spring isolation roof curbs are specified the installing contractor is required to verify factory installed tie-down bolts, located at the fan / motor isolation base(s), remain in a locked down condition.
- C. At the direction of the Owner's Representative the contractor shall remove and dispose of filters from the respective units and install a new filter obtained from the Extra Materials required in Part 1 of this specification. If additional filter installation is not required, forward filters to the owner as extra stock, at the completion of the project.

**3.5 CONNECTIONS**

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.

3.6 FIELD QUALITY CONTROL

- A. Engage a factory service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections and to provide start-up service. Unit or components will be considered defective if unit or components do not pass tests and inspections. Prepare test and inspection reports.

3.7 CLEANING

- A. After completing system installation, testing, adjusting, and balancing and after completing startup service, clean rooftop units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION AND STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service and to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237510



**SECTION 238121 – DUCTLESS SPLIT SYSTEM UNITS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes packaged mini-split cooling only systems.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Provide wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Provide operation and maintenance Data.

**1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain all mini-split units and accessories through one source from a single manufacturer, regularly engaged in production of heat pumps and the associated components.
- B. All units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- C. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.
- D. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210/240 and bear the ARI Certification label.
- E. A dry air holding charge shall be provided in all indoor units.
- F. All outdoor units shall be pre-charged with R-410A refrigerant.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All system components shall be stored and handled in accordance with the manufacturer's recommendations.

1.6 WARRANTY

- A. Provide written warranty indicating the entire installation will be warranted for a period of 1 year from the date of substantial completion. The warranty will include all parts, materials and labor for replacement of any of the unit's components that fail in materials and/or workmanship within the warranty period.
- B. In addition to the above, all units shall have a manufacturer's parts and defects warranty for a period five (5) year from date of installation. All compressors shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. The warranty does not include labor.

1.7 EXTRA MATERIALS

- A. In addition to the equipment and materials furnished with the mini-split systems, furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing the contents:
  - 1. Filters: provide two additional filter(s) for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide mini-split units manufactured by Mitsubishi Electric. Subject to review, equipment meeting the full requirements of the specifications and project installation limitations and manufactured by one of the following will be considered:
  - 1. Carrier.

2.2 WALL MOUNTED INDOOR UNITS

- A. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- B. Unit Cabinet: All casings shall have a white finish. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard. There shall be a separate back plate which secures the unit firmly to the wall.

- C. Fan: The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right). A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- D. Filter: Return air shall be filtered by means of an easily removable, washable filter.
- E. Coil: The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory.
- F. Electrical: The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 to 253 volts. The power to the indoor unit shall be supplied from the outdoor unit using the manufacturer's recommended system. Provide conductor wire and ground per manufacture's requirements.

### 2.3 OUTDOOR UNITS

- A. General: Provide outdoor units compatible with the indoor units. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions. The system shall be capable of cooling operation down to ambient temperature of 0°F for heat pump systems and -20°F for cooling only systems without additional low ambient controls. The outdoor unit shall be able to operate with a maximum height difference of 100 feet between indoor and outdoor units.
- B. Cabinet: Provide a casing constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability. Easy access shall be afforded to all serviceable parts by means of removable panel sections. The fan grill shall be of ABS plastic.
- C. Fan: Provide single or dual DC fan motors. The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.
- D. Coil: The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve metering device which shall be a microprocessor controlled step motor. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ACR Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free, elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a - Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50.

- E. Compressor: The compressor shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.
- F. Electrical: The electrical power of the unit shall be 208 volt, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. Power for the indoor unit shall be supplied from the outdoor unit via a factory controller. The power to the indoor unit shall be supplied from the outdoor unit.

## 2.4 CONTROLS

- A. Provide wall mounted thermostat for each system.
- B. Provide all required wiring and controls including two microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat. P

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install unit(s) level and plumb.
- B. Install outdoor unit(s) per manufacture's installation instructions. Where indicated provide roof support curbs.
- C. Provide pipe portals for installation of refrigerant piping.
- D. Install roof-mounted compressor-condenser components on roof support curbs.
- E. Provide a complete and operational system including remote thermostat with back box and all control and line voltage wiring as necessary.

### 3.2 CONNECTIONS

- A. Provide all required refrigerant piping and specialties including insulation on the refrigerant pipe.
- B. Install piping adjacent to the indoor and outdoor units with clearance for servicing.

3.3 COMMISSIONING

- A. Engage a factory-authorized service representative to perform startup service and to train Owner's maintenance personnel to adjust, operate, and maintain units. Start-up to include complete testing of all controls and unit operation. Provide records of all start-up procedures and provide copies of this data are to the owner.

END OF SECTION 238121





**SECTION 238255 – GAS FIRED UNIT HEATERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes natural gas fired unit heaters and accessories.

**1.3 SUBMITTALS**

- A. Product Data: For each type of gas fired unit heater indicated. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: Include plans, elevations, sections, details and wiring diagrams: for power and control wiring.
- C. Operation and Maintenance Data: For fuel-fired unit heaters to include in emergency, operation, and maintenance manuals.

**1.4 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of fuel-fired unit heater that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 GAS FIRED UNIT HEATERS**

- A. Manufactures: Subject to compliance with requirements, provide gas fired unit heaters manufactured by Reznor, Model UDAS. Subject to review, equipment meeting the full requirements of the specifications, manufactured by Sterling or Modine will be considered.
- B. Cabinet: The cabinet shall be low profile with a pre-coat or powder coat white paint finish. Finish shall be a minimum 80 gloss on G30 galvanized steel. The cabinet shall be constructed so that screws are not visible from the bottom, front, or sides, except for service panel and accessories. Unit construction shall incorporate a beveled front corner on control side for additional cabinet

rigidity. All units shall be manufactured with a tooled drawn supply air orifice on the rear panel to reduce fan inlet noise. The unit shall be designed for ceiling suspension featuring 3/8"-16 female threads (hanger kits for 1" pipe) at both 2-point and 4-point locations with no additional adapter kits. The cabinet shall be equipped with roll-formed horizontal louvers. Louvers shall be spring held and adjustable for directing airflow. The cabinet shall be equipped with a full safety fan guard. The enclosed motor and fan assembly shall be resiliently mounted to the cabinet to reduce vibration and noise. The unit shall be designed with a full opening service access panel complete with screw closure attachment and lifting handle for removal. Service panel shall be fully gasketed and equipped with a safety interlock switch. All components in the gas train, all standard electrical controls, and the power venter shall be within the sealed service compartment.

- C. Heat Exchanger: The heater shall be equipped with a multi-cell, 4 pass serpentine style steel heat exchanger. Heat exchanger tubes shall be press fabricated of stainless steel. All heat exchangers shall be fabricated with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.
- D. Gas Burner: The units shall incorporate a single, one piece burner assembly with a single orifice. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior. All units shall have a single venturi tube and orifice supplying fuel to a one-piece burner housing. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.
- E. Controls: Controls shall include a two-stage gas valve; direct spark multi-try ignition with electronic flame supervision with timed lockout integrally controlled via a printed circuit control board. The control board shall also incorporate diagnostic lights, DIP switches for fan overrun settings, and a relay for fan only operation. All units shall be equipped with a safety limit switch. All controls shall be enclosed in the sealed control compartment to protect them from accidental damage, dust and atmospheric corrosion.
- F. Combustion Air and Venting: The unit shall have a factory-installed power venter device to draw combustion air from outside of the building. The outside air shall enter the unit through a factory-installed round inlet air terminal on the rear of the heater. The control compartment shall be sealed and the access door shall be gasketed to prevent dirt, lint, dust or other contaminants present in the heated space from entering the unit. The control compartment door shall be equipped with a safety interlock switch to prevent operation when the door is open. The combustion air supply pipe and flue exhaust pipe shall be run in parallel from the heater to a factory supplied concentric adapter assembly, which allows for a single wall or roof penetration, to the air inlet and vent terminal. The combustion air/venting system shall include a vibration isolated power venter motor and wheel assembly and a combustion air pressure switch. Provide a flame rollout switch. Provide exhaust vent and air intake connection with materials as recommended by the unit heater manufacture.
- G. Electrical: Operation shall be controlled by an integrated circuit board that includes LED diagnostic indicator lights. Supply voltage connections shall be made in a sealed junction box. 24-volt control connections shall be made on an externally mounted terminal strip. All internal wiring, both line and control voltages, shall be terminated by insulated terminal connectors to minimize shock hazard during service. Each unit shall be equipped for use with 115/1 volt power supply.
- H. Provide thermostat with guard and locking cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and connect gas fired unit heaters and associated fuel and vent features and systems according to NFPA 54, National Fuel Gas Code, all applicable local codes and regulations, and manufacturer's written installation instructions. Suspend from the building steel per the manufacture's installation instructions. Adjust hangers so all units are level and plumb.
- B. Provide all required combustion air intake and exhaust vents as indicated on the manufacturer's installation instructions.
- C. Install wall mounted thermostat including back box and all required control wiring.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Verify bearing lubrication.
  - 3. Verify proper motor rotation.
- C. Remove and replace malfunctioning units.

3.3 ADJUSTING

- A. Adjust initial temperature set points. Adjust burner and other unit components for optimum heating performance and efficiency.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fuel-fired unit heaters.

END OF SECTION 238255



**SECTION 238260 – ELECTRIC HEAT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings 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 various types of electric heaters. Refer to the contract drawings for required accessories and other components.

**1.3 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Source Limitations: Obtain all electric heating units through one source from a single manufacturer, regularly engaged in production of the components and who issues complete catalog data on the product offering.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include the following:
  - 1. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 4. Location and arrangement of integral controls.
  - 5. Wiring Diagrams: Power, signal, and control wiring.
- D. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 WALL HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products manufactured by Q-Mark. Heaters manufactured by others may be considered if equal as judged by the Engineer.
- B. Heaters to be UL listed. Refer to the drawings for the required voltage.

- C. The heater shall be designed for surface or recessed mounting.
- D. Back-box: Provide back-box designed as a recessed rough-in box in either masonry or frame installations and is also used with the surface mounting frame in surface mounted installations. The back-box shall be 20 gauge galvanized steel and shall contain knockouts through which power leads are installed.
- E. Inner Frame Assembly: Provide an inner frame assembly consisting of a 20-gauge steel chassis to mount the heating element, fan motor and blade, fan control and thermal cutout. The inner frame assembly shall be completely pre-wired.
- F. Heating Element: The heating element shall be of non-glowing design consisting of a special resistance wire, enclosed in a steel sheath to which steel plate fins are brazed. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.
- G. Motor and Controls: The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor. Fan control shall be bi-metallic, snap-action type and shall activate fan after heating element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. Thermal cutout shall be bi-metallic, snap-action type designed to shut off heater in the event of overheating and reactivate the heater when temperatures return to normal.
- H. Disconnect Switch: Provide a factory installed double pole single throw disconnect switch shall be provided for positive disconnect of power supply. The disconnect will be completely concealed behind the front cover.
- I. Front Cover: Provide a louvered front cover constructed of commercial grade steel finished in white baked enamel. The cover will attach to the fan deck via snaps in the plastic trim pieces and shall have no exposed screw heads.
- J. All sheet metal parts, except the front cover and galvanized back box shall be phosphatized, then completely painted by a baked enamel painting process.
- K. Provide wall mounted or integral thermostat as indicated on the drawings. Provide all required control wiring.

## 2.2 CEILING HEATERS- Less than 2 kw

- A. Manufacturers: Subject to compliance with requirements, provide products manufactured by Q-Mark. Heaters manufactured by others may be considered if equal as judged by the Engineer.
- B. Ceiling heaters to be UL listed.
- C. Refer to the drawings for unit voltage and heating capacity.
- D. The heater shall be designed for surface or recessed mounting. For surface mounting. For surface mounting provide a mounting frame.
- E. Back-box: Provide back-box designed as a recessed rough-in box in either masonry or frame installations and is also used with the surface mounting frame in surface mounted installations. The back-box shall be 20 gauge galvanized steel and shall contain knockouts through which power leads are brought.

- F. Inner Frame Assembly: Provide an inner frame assembly consisting of a 20-gauge steel chassis to mount the heating element, fan motor and blade, fan control and thermal cutout. The inner frame assembly shall be completely pre-wired.
- G. Heating Element: The heating element shall be of non-glowing design consisting of a special resistance wire, enclosed in a steel sheath to which steel plate fins are brazed. The element shall cover the entire air discharge area to ensure uniform heating of all discharge air.
- H. Motor and Controls: The fan motor shall be impedance protected, permanently lubricated and with totally enclosed rotor. Fan control shall be bi-metallic, snap-action type and shall activate fan after heating element reaches operating temperature, and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. Thermal cutout shall be bi-metallic, snap-action type designed to shut off heater in the event of overheating and reactivate the heater when temperatures return to normal.
- I. Disconnect Switch: Provide a factory installed double pole single throw disconnect switch shall be provided for positive disconnect of power supply. The disconnect will be completely concealed behind the front cover.
- J. Front Cover: Provide a louvered front cover constructed of commercial grade steel finished in white baked enamel. The cover will attach to the fan deck via snaps in the plastic trim pieces and shall have no exposed screw heads.
- K. All sheet metal parts, except the front cover and galvanized back box shall be phosphatized, then completely painted by a baked enamel painting process.
- L. Provide wall mounted thermostat with back box and all required control wiring.

### 2.3 CABINET UNIT HEATERS – Larger than 2 kw

- A. Manufacturers: Subject to compliance with requirements, provide products Cabinet Unit Heaters Model CU as manufactured by Q-Mark. Heaters manufactured by others may be considered if equal as judged by the Engineer.
- B. Ceiling heaters to be UL listed.
- C. Refer to the drawings for unit voltage and heating capacity.
- D. Heaters to be suitable for ceiling or wall mounting. Refer to the drawings for mounting requirements.
- E. Cabinet: The cabinet shall be of heavy duty cold-rolled steel. The heater front covers shall be securely attached to the cabinet with a maximum of two slotted head style spring latches and easily removable for access to elements, filters and control panel.
- F. Cabinet shall be finished in a color to be selected by the Architect from the manufacture's standard colors.
- G. Heating Elements: The heating elements shall be of non-glowing design consisting of 80/20 NiChi resistance wire enclosed in a steel sheath to which steel plate fins are brazed. The heating element shall be located directly in front of the blower discharge air for uniform heating



- H. Safety Thermal Cutouts: Provide thermal safety cutouts to automatically shut off the heater in the event of overheating.
- I. Motor and Blower Assembly: The motor(s) and blower(s) shall be direct drive and resiliently mounted on a rigid heavy duty frame for quiet operation and long life. The motor(s) shall be two speed 1/8 H.P. with automatic reset overload protection. The motor shall be vented and mounted in the air stream to provide maximum cooling of the motor(s). Motor(s) fuse protection shall be provided to meet UL and NEC requirements. The blower(s) shall be forward curved, double inlet, centrifugal type with discharge directly on the full length of the elements to provide uniform discharge air temperatures.
- J. Filters: Provide permanent washable filter to be located ahead of the motor and blower assembly to ensure clean air circulation. Filter shall be easily removed for changing or cleaning by removing the front panel and pulling on the filter.
- K. Heater shall be provided with an electrical interlock to shut down the heater when the front cover is opened to provide safety to the maintenance personnel during filter cleaning (replacement) or other maintenance
- L. Fan Delay Control - Fan control shall delay start-up of the fan motor(s) until the heating elements have warmed up. It shall maintain motor operation after heating elements have been de-energized to dissipate residual heat.
- M. Where indicated provide wall mounted thermostat with back box and all required control wiring.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance. Examine roughing-in for electrical connections to verify actual locations before unit heater installation. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof.
- B. Install cabinet unit heaters to comply with NFPA 90A.

#### 3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Operate electric heating elements through each stage to verify proper operation and electrical connections. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238260



## SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 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.

#### 1.2 SUBMITTALS

- A. Follow the procedures specified in Division 1.
- B. Submittals must be provided with all catalog information clearly identified indicating all options to be provided as part of the product. Any submittal not containing this information will be rejected.
- C. Provide the following shop drawings in booklet form:
1. Light fixtures cuts shall be submitted all at one (1) time in a single packet.
  2. Electrical switchgear, including, but not limited to panelboards, transformers, disconnect switches, manual motor starters, combination motor starters / disconnect switches, and contactors shall be submitted all at one (1) time in a single packet. All equipment shall be of one manufacturer.
  3. Wire devices shall be submitted all at one (1) time in a single packet and be from one (1) manufacturer.
  4. Occupancy sensors shall be submitted all at one (1) time in a single packet and be from one (1) manufacturer whether connected to a lighting control system or provided with power packs, unless noted otherwise. Layout drawings may be submitted after the devices are approved.
  5. **All required layout drawings shall be shown on architectural backgrounds and not the electrical drawings to ensure that the manufacturer locates all devices. It is the contractor's responsibility to acquire the CAD drawings per Division 1 requirements.**

#### 1.3 PRODUCT REVIEWS AND SUBSTITUTIONS

- A. Refer to Division 1 for substitutions requirements under this contract. Division 1 requirements supersede requirements listed elsewhere.
- B. No substitutions will be reviewed by the Engineer after the Bid Due Date unless specifically requested by the Owner or Architect in writing with an associated credit, proposed by the contractor, included with the substitution request.

1.4 SHOP DRAWINGS

- A. Refer to the Conditions of the Contract (General and Supplementary) and Division-1 for submittal definitions, requirements, and procedures.
- B. Where submittals include multiple items, a bill of material (not including quantity) shall be provided at the front of the shop drawing. The bill of material shall include product identification, manufacturer and model number.
- C. Submittal of Shop Drawings, Product Data, and Samples will be reviewed only when submitted by the Prime Contractor. Submittals from sub-Contractors and material suppliers directly to the Architect/Engineer will not be reviewed. No equipment/materials shall be installed until the Shop Drawings have been stamped with "No Exceptions Taken" or "Make Corrections Noted" by the Architect/Engineer.
- D. Submit Shop Drawings as listed in each specification section. Following is a list of shop drawings to assist the contractor; however, the contractor shall supply all shop drawings as listed in each individual section whether listed below or not.
  - 1. Coordination Drawings.
  - 2. Electrical Systems Commissioning.
  - 3. In Ground Boxes.
  - 4. Distribution Panelboards
  - 5. Power and Lighting Panelboards.
  - 6. Dry Type Transformers.
  - 7. Disconnect Switches.
  - 8. Individually-Mounted Circuit Breakers.
  - 9. Combination Motor Starter/Disconnect Switches.
  - 10. Fuses.
  - 11. Contactors.
  - 12. Thermal Overload Switches.
  - 13. Wiring Devices and Wall Plates.
  - 14. Overhead Drop Reel Cords.
  - 15. Surface Raceway.
  - 16. Dimmer Switches.
  - 17. All Lighting Fixtures (submit in booklet form and with detail drawings where required).
  - 18. Low Voltage Lighting Control Equipment and associated wiring diagrams and layout drawings.
  - 19. Occupancy Sensors and associated layout drawings.
  - 20. Transient Voltage Surge Suppression.
  - 21. Fire Alarm Equipment and associated wiring diagrams, and layout drawings.
  - 22. Data Equipment including, but not limited to equipment shop drawings, warranty information, Installer information, testing information and layout drawings.
  - 23. CATV including, but not limited to equipment shop drawings, testing information and layout drawings.
  - 24. Cable Tray.
  - 25. Intercommunication, Time Signal, and Sound System Equipment with associated wiring diagrams and layout drawings.
  - 26. Classroom A/V equipment.
  - 27. Access Control Equipment and associated wiring diagrams and layout drawings.
  - 28. Closed Circuit Television Equipment and associated wiring diagrams.
  - 29. Fire Stopping Material.

- E. When preparing submittals and any required final programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers.
- F. Submittal Plans: Submittal plans **MUST** be provided with only the system being presented. Plans not submitted that have not been cleaned of extraneous systems (i.e. a low voltage system being installed on the power drawing, showing all the power and other low voltage systems), will be grounds for immediate rejection without review.

#### 1.5 COORDINATION SUBMITTALS

- A. The Contractor shall coordinate with other trades, and provide building coordination drawings for all major components. Following is a MINIMUM list of components that must be included on the coordination drawings; however, the Contractor must also include all other components and systems of substantial size to ensure proper coordination.
  - 1. Conduit pathways, denoting pathways for larger conduits (3" and larger) as well multiple runs of smaller conduits.
  - 2. Cable tray.
  - 3. Switchgear (panelboards, transformers, large disconnect switches (200A and larger).
  - 4. Transient voltage surge suppression equipment.
  - 5. Lighting.

#### 1.6 PRODUCT OBSOLESCENCE

- A. In all cases, the most current iteration of the specified product shall be submitted. Where the specified product is no longer manufactured, the contractor shall submit an equivalent product with the same or better specifications. Where specific manufacturers are specified, the contractor shall supply from the same manufacturer the recommended replacement; however, under no circumstances shall the replacement product be deficient in any aspect to the specified product.
- B. In the submittal for the product, the Contractor shall provide a signed letter clearly indicating the reason for the replacement product, and confirmation that the replacement product meets or exceeds all of the specified product's specifications to the best of the Contractor's knowledge.
- C. The replacement product shall be provided at no additional cost to the owner, and shall not constitute any extension to the project schedule.
- D. These requirements shall be inclusive to requirements listed elsewhere in the specifications, and shall not void any other requirements.

#### 1.7 INSPECTIONS

- A. The Contractor shall provide certificates of approval, in triplicate, for service equipment, building rough wiring, and building finished wiring.
- B. Inspection certificates shall be submitted to the Engineer within 30 days after the inspections are made. Contractor shall use an independent NEC Certified Inspection Agency as the approved agency. Contractor must verify that the Certified Inspection Agency is approved by the local municipality and the Owner to inspect electrical installations in the project locality. All inspection certificates must be received before final payment can be made.

- C. Refer to General Conditions for additional information.

#### 1.8 INDEPENDENT COMMISSIONING

- A. Independent Commissioning of electrical systems meeting local and state codes, and owner requirements shall be provided as part of this project. The independent commissioning authority may be hired by this Contractor, another project Contractor or the Owner, as indicated in the documents. However, this does not absolve the installing Contractor and manufacturer from ensuring full functionality of the systems, and manufacturer commissioning as outlined in the individual sections.
- B. The Contractor shall schedule and coordinate shop drawing submissions, systems installation and systems start-up with the commissioning authority as required to allow the commissioning authority to perform their work.
- C. Commissioning of the lighting control system shall take place on every project, and shall meet the local currently adopted version of the International Energy Conservation Code. This Contractor shall ensure this takes place, and contract with the applicable party as required.

#### 1.9 MANUFACTURER'S REQUIREMENTS

- A. All material shall be new, of the best respective kinds, manufactured by the company or companies mentioned and shall be of domestic manufacture unless specified otherwise.
- B. All equipment, material or apparatus of any one system must be the product of one Manufacturer, or system tested products.
- C. Manufacturers not listed in the Contract Documents must submit to the Engineer, via a Bidding Contractor, all product information per Division 1 requirements.

#### 1.10 NAMEPLATE DATA

- A. Each item of power operated equipment shall be provided with a permanent operational data nameplate on indicating Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Nameplates shall be located in an accessible location.

#### 1.11 FAMILIARITY WITH PROPOSED WORK

- A. All Contracts are with the understanding that the Contractor, prior to submission of his bid, acquainted himself with the requirements of the Drawings and Specifications, including "Conditions of the Contract," conditions of the site, its terrain, soil conditions, all other requirements of the Contract, and that he obtained all information necessary for completion of the work on or before the date specified for receiving of bids.
- B. In all cases where a device or part of the equipment is herein referred to in the singular, such reference shall apply to as many such items as are required to complete the installation.
- C. "Existing" information does not necessarily represent "as-built" conditions. The Contractor shall verify all existing conditions. If discrepancies are found the Contractor shall notify the Architect/Engineer for a resolution before proceeding.

1.12 DEFINITIONS

- A. The terms "The Contractor" or "This Contractor" mentioned in these Specifications refers to the Electrical Contractor responsible for the work and equipment included in these Specifications.
- B. The term Sub-Contractor refers to any reference to, or letting of work contained in these Specifications to any Sub-Contractor or Manufacturer by the Prime Contractor. This does not relieve the Prime Contractor of his responsibility for all work, material and equipment in this Specification.
- C. The term "Provide," when used separately, shall mean to "Furnish and Install."
- D. The term "Furnish," when used separately, shall mean to obtain and deliver on the job for installation by other trades.
- E. The term "Install," when used separately, shall mean to mount in place, connect and make operable.

1.13 INTENT OF THE DRAWINGS AND SPECIFICATIONS

- A. The Drawings which accompany the Specifications are for the purposes of illustrating the character and extent of the work, and are subject to such modifications by Architect/Engineer as may be found either necessary or advisable before ordering the prosecution of the work. The Contractor shall conform to and abide by whatever Supplementary Drawings and explanations which may be furnished by the Architect/Engineer for the purpose of illustrating the work. The Architect/Engineer shall decide as to the meaning or intention of any portion of the Specifications and Drawings.
- B. Where the work is shown in complete detail on only half or a portion of a Drawing, or there is an indication of continuation, the remainder being shown in outline, the work drawn out in detail shall be understood to apply to other like portions of the structure. All work that may be called for in the Specifications and not shown on the Drawings, or shown on the Drawings and not called for in the Specifications, shall be executed and furnished by the Contractor as described in both.
- C. Should any incidental work or materials be required, but not set forth in the Specifications or Drawings, either directly or indirectly, but which is necessary to fulfill the intent thereof, the Contractor is to understand same to be implied and required, and he shall perform all such work and furnish all such materials as fully as if they were particularly delineated or described, without additional cost to Owner. This shall include all materials, devices, methods peculiar to the machinery, equipment, apparatus, or systems as described herein.

1.14 EQUIPMENT ENCLOSURE RATINGS

- A. Electrical equipment installed within the building shall carry a NEMA rating 1 or higher if indicated in the specifications or on the drawings.
- B. Electrical equipment installed outside the building, or in environmentally wet locations shall carry a NEMA rating 3R or higher if indicated in the specifications or on the drawings.
- C. Electrical equipment installed in harsh environments (i.e. natatoriums, greenhouses, etc.) shall carry a NEMA rating 4X, and be manufactured from stainless steel.
- D. Where specifications and drawings conflict (i.e. drawings indicated NEMA 3R, but specifications indicate NEMA 1), the higher rating shall be provided at no additional cost to the project.



1.15 WIRING LAYOUTS

- A. Should it become necessary to rearrange any of the circuit or feeder wiring, approval to do so shall first be obtained from the Engineer. The Contractor will be supplied with a spare set of Drawings on which all such approved changes shall be noted. Upon completion of all work under this Contract, these Drawings shall be returned to the Architect/Engineer, who will issue a receipt for same.

1.16 FIELD MEASUREMENTS

- A. Before ordering any materials or doing any work, Contractor shall verify all measurements at the building site, and shall be responsible for correctness of same. At no time shall the Contractor scale Drawings for the purpose of installation.
- B. No extra compensation will be allowed on account of differences between actual dimensions and those indicated on the Drawings. Any difference which may be found shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

1.17 COORDINATION

- A. The Contractor shall cooperate with the other Contractors and shall arrange to eliminate conflicts with the equipment and work of the Contractors.
- B. The Contractor shall be responsible for coordinating all electrical devices/equipment with the casework before rough-in. Any conflicts with casework and electrical devices/equipment shall be brought to the attention of the Architect/Engineer before rough-in. Any electrical device/equipment installed in conflict with casework shall be removed and reinstalled at the Contractor's expense.
- C. The Contractor shall be responsible to coordinate all electrical conduits which are installed for rooftop equipment. Where the equipment can be fed from within the equipment curb, the contractor shall utilize this space. Where the equipment must be fed from the exterior, the contractor shall furnish and install a roof curb designed for conduit penetrations.

1.18 CHASES AND OPENINGS

- A. The Contractor shall determine, in advance, the locations and sizes of all chases and openings necessary for the proper installation of his work and have same provided during construction. Any chase or opening not made during construction, due to the Contractor's failure to determine same in advance, shall be done by the Contractor at his own expense. Any unnecessary cutting shall be repaired to match the original conditions of the area disturbed at the Contractor's expense.

1.19 AIR PLENUMS

- A. The Contractor shall use a conduit system or approved plenum rated wiring for all wiring located above ceilings.

1.20 RECORD DOCUMENTS

- A. Refer to Division 1 for Record Document requirements. The following requirements supplement the requirements of Division 1.
- B. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned from column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; work performed via Change Orders; concealed control system devices.
- C. Mark Specifications to indicate changes by addendum or Change Orders; actual equipment and materials used.
- D. All new underground utilities shall be marked and dimensioned on site plan as-built drawings.

1.21 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1 for Operation and Maintenance Manual requirements.
- B. Contractor shall provide Operation and Maintenance data listed in individual section in addition to requirements listed in Division 1.
- C. **Included with operation and maintenance data, under a separate tab or volume, complied into a single place, shall be manufacturer recommended preventative maintenance measures for each piece of equipment installed as part of this project.**

1.22 WARRANTIES

- A. Division 1 warranties shall be considered minimum warranties. Any warranties listed in the individual sections that are longer than Division 1 warranties shall be honored.
- B. Refer to individual sections for warranty requirements beyond those as specified in Division 1.

1.23 TEST AND ADJUST

- A. All systems installed under this Contract shall be tested and adjusted to ensure that all equipment and systems meet or exceed the specified requirements.

1.24 PHASE LOAD BALANCE

- A. A reasonable balance shall be secured on the phases of all main distribution feeders and bus bars.
- B. Following installation and with the system in operation, the Electrical Contractor shall check the balance and rearrange connections so that the ampacity on any of the two single-phase phases of the main bus shall not vary more than 10% of each other.

1.25 PAINTING

- A. Refer to the Division 1 for general painting requirements.

- B. The Contractor shall be responsible for all touch up painting on this project for electrical work.
- C. The Contractor shall be responsible for painting of all conduits that is installed after general painting has been completed.

1.26 CLEANING

- A. Refer to Division 1 Section, "Project Closeout" or "Final Cleaning" for general requirements for final cleaning.
- B. The Contractor shall keep the building free of rubbish and material during the course of construction insofar as the work under this Contract is concerned.
- C. Upon completion of the project, the Contractor shall remove all rubbish, surplus equipment and shipping labels and have all areas broom clean. The Contractor shall thoroughly clean all fixtures, and other electrical equipment, leaving same in first-class working condition.

1.27 INSTRUCTION OF OWNER'S PERSONNEL

- A. The Contractor shall provide instruction of the owner's personnel as outlined in Division 1. The following requirements shall be included in addition to Division 1 requirements.
- B. The Contractor shall provide the services of competent personnel and/or Manufacturer trained personnel to instruct employees designated by the Owner in the proper operation, care and maintenance of the equipment and system installed under the Contract.
- C. A letter of certification itemizing the equipment, system, instructor, and bearing signatures of the employees instructed shall be delivered to the Engineer and the Owner upon completion of the project. The letter of certification shall note the number of hours spent in explanation and actual operation of system with maintenance personnel. If the Contractor cannot turn over this letter of certification with employee signatures, the Contractor shall be prepared to provide additional owner training, meeting the specification requirements, at no additional cost to the owner.
  - 1. The Contractor shall keep notes of all of the training sessions, list discussion topics, questions and answers. The contractor shall provide these typed meeting minutes of the training sessions to all of the attendees and owner's representative. A final copy of these minutes shall also be provided with the O and M manuals for the applicable product.
- D. The Contractor shall be responsible to video record each trained presentation session with the owner and the manufacturer and turn over the recordings to owner after completion of training session. The recordings may be turned over on DVD or Thumb drive. The Contractor shall obtain a signed receipt for the recordings proving the owner received them. If a copy of the receipt cannot be turned over and validated when requested, the contractor shall be responsible to provide additional training sessions as requested. A generic training video shall be acceptable in lieu of recording the owner's training session; however, this does not absolve the contractor of providing a private training session with the owner.

1.28 DELIVERY AND STORAGE OF MATERIALS

- A. Refer to the Division 1 for delivery and storage of materials requirements.

- B. The Contractor shall provide for, or secure use of, suitable-dry storage space for the safe delivery and storage of his materials. The Contractor shall be responsible for providing their own storage trailers on site. The use of Owner's inside-building storage will not be permitted, unless specifically noted otherwise.

1.29 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Responsibility for care and protection of electrical work rests with the Contractor until it has been tested and accepted by the Owner. After delivery, before and after installation, protect equipment and materials against theft, injury, or damage in all cases.
- B. Protect equipment outlets, and pipe openings with temporary plugs, caps, or burlap. Electrical conduit openings shall be covered with capped bushing or fiber disks and bushings.
- C. The contractor shall be responsible to protect all existing electrical or communications equipment to remain from construction dirt and debris, whether created from this contractor or another contractor. The contractor shall determine the method needed to protect each piece of equipment to remain. Should existing equipment be damaged during demolition it will be the responsibility of the contractor to provide necessary repairs or replacement of the damaged equipment.

1.30 SCAFFOLDING AND HOISTING

- A. The Contractor shall provide all lumber and other material required for the erection of all staging, scaffolding, shoring, protective platforms, railings and ladders. Scaffolding shall be removed at the completion of the work.
- B. The Contractor shall protect any flooring that is to remain. The Contractor shall inspect the flooring before the scaffolding is installed and report any damage that exists before the start of construction. The Contractor shall be responsible to repair any damage to the flooring after the scaffolding is removed to the acceptance of the owner at no additional cost to the owner.

1.31 PERMITS AND FEES

- A. Refer to the Division 1 for Permits and Fee requirements.
- B. Unless noted otherwise, all electrical work permits, certificates, tests, and inspection fees required for the electrical work provided under this contract shall be paid by the Contractor, including any electrical licenses required to work on the project.

1.32 UTILITY COMPANY FEES OR CHARGES

- A. Unless noted otherwise, all utility company (Electric) fees or charges will be paid by the Contractor directly to the utility companies.

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 -25 for rough-in requirements.

**3.2 EXTERIOR AND INTERIOR EXCAVATION**

- A. Prior to any digging outside and inside the building, the Contractor shall review all available existing documentation and review the excavation path with the owner's representative to help determine the location of existing utilities and structures. Following review of this documentation, the Contractor shall provide Ground Penetrating Radar (GPR) to ensure there are no utilities in the area of excavation. Should any utilities be found, the contractor shall provide information to the engineer, architect and owner and propose alternate locations for the excavation. If the contractor neglects to perform the research and GPR prior to excavation and destroys any underground utilities, it shall be the responsibility of the contractor to repair the utilities to the engineer, architect and owner's satisfaction without any additional cost to the owner.

**3.3 CUTTING AND PATCHING**

- A. Perform cutting and patching in accordance with Division 1. In addition to the requirements specified in Division 1, the following requirements apply. The Contractor shall be responsible for providing all cutting and patching required to perform his work unless noted otherwise.
- B. Perform cutting, fitting, and patching of electrical equipment and materials required to:
  - 1. Uncover work to provide for installation of ill-timed work.
  - 2. Remove and replace defective work.
  - 3. Remove and replace work not conforming to requirements of the Contract Documents.
  - 4. Remove samples of installed work as specified for testing.
  - 5. Install equipment and materials in existing structures.
  - 6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.
- C. 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.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- F. Unless noted otherwise, where equipment is being provided on existing roofing systems, the contractor shall provide all roof patching where he penetrates the roof. The roof patching must be performed by an authorized vendor of the roofing system, maintaining all existing roofing warranties. The Contractor must contract with the owner's existing roofing vendor all roofing work.

**3.4 PROTECTION OF INSTALLED WORK**

- A. During construction activities, including cutting and patching operations, protect adjacent installations.
- B. Patch existing finished surfaces and building components using new materials matching existing materials and experienced installers. For installers' qualifications refer to the materials and methods required for the surface and building components being patched.

**3.5 ELECTRICAL INSTALLATION**

- A. Coordinate electrical equipment and material installation with other building components. Verify all dimensions by field measurements. If no dimensions are given, Contractor shall verify with Architect or Engineer before starting work. At no time shall the Contractor scale Drawings for the purpose of locating items.
- B. Provide for chases, slots, and openings in other building components to allow for electrical installations. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- C. 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.
- D. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible, or to meet current local, national and ADA codes.
- E. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- F. Install systems, materials, and equipment to conform with 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 Architect/Engineer.
- G. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- H. 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.
  - 1. Contractor shall also take care to leave access to other systems located behind electrical components being installed as part of this project. Should it be found that access has been blocked to other equipment requiring access (i.e. filters, valves, etc.), the offending system will be required to be removed and reinstalled at no additional cost to the owner.
- I. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 26 "Common Requirements – Electrical."

- J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Where exterior conduits, duct banks, equipment and pads are installed by this contractor, the contractor shall follow all NEC requirements, as well as those requirements listed on the drawings and in the specifications. Where excavation, both interior and exterior, is indicated to be performed by this contractor, backfill shall also be performed, meeting all requirements of the applicable drawing notes and specifications. Backfill shall include clean earth and/or stone, as specified in the applicable specifications, placed and tamped as indicated in the specifications. Provide all testing as outlined in the applicable specifications.
- L. Electrical component installation in spaces where abuse may occur (i.e. gymnasiums, locker areas, exterior areas) shall be provided with vandal covers. Covers shall be provided with a means to be locked. System components include, but are not limited to light switches/dimmers, occupancy sensors, sound system controls, fire alarm devices, clocks, wireless access points, etc.

### 3.6 LOW VOLTAGE WIRING INSTALLATION

- A. All low voltage wiring, installed above ceilings, must be plenum rated, unless noted otherwise. Wiring shall be installed perpendicular to steel, located in j-hooks and/or cable tray as available and allowed. Refer to individual specification and drawings for allowance if cable installation in cable trays.
- B. All low voltage wiring, installed in spaces without ceilings, must be installed within conduit or other approved raceway. This requirement shall apply to finished spaces (i.e. gymnasium, etc.) and unfinished spaces (i.e. mechanical rooms, electrical rooms, etc.) Under no circumstances is exposed wiring acceptable.
- C. The contractor shall be responsible to provide surge protection for all low voltage systems where copper lines leave and/or enter a building. System shall include, but not be limited to, voice, fire alarm, CCTV, television and security. All surge protection for low voltage systems shall be solid state, unless otherwise noted.

### 3.7 ELECTRICAL REQUIREMENTS FOR EQUIPMENT INSTALLATION

- A. Conduit and power wiring of required size and voltage, from a panelboard or similar source, shall be furnished and installed by this Contractor, to the equipment furnished by another Contractor. A junction box or means of disconnect (as required) shall be furnished and installed at the equipment by this Contractor meeting the National Electric Code.
- B. Unless noted otherwise, a full complement of electrical control components, required for the intended use and/or operation of specified equipment, including variable frequency controllers, speed controllers and/or other control devices required, whether integral or remote, shall be furnished by the Contractor furnishing the equipment. These control devices as well as power wiring (where required) through these devices shall be installed by this Contractor.

**3.8 CONTROL WIRING FOR EQUIPMENT INSTALLED BY ANOTHER CONTRACTOR**

- A. This Contractor shall be responsible for providing all required control wiring, (except HVAC system control wiring) for any equipment provided by another Contractor which shall include, but not be limited to, motorized backboards, screens, partitions, curtains, motor operated doors, etc, unless noted otherwise.
- B. The Contractor shall provide all boxes and conduit required for any equipment provided by another Contractor. Control wiring shall also include any wiring of motion or occupancy sensors for doors, curtains, etc.
- C. Coordinate all required work for a complete and functional system with the Contractor supplying the equipment. Make all required connections.
- D. Prior to installing any control wiring to any equipment, acquire control wiring diagrams and direction from the installing contractor.

**3.9 TEMPORARY ELECTRIC/TELEPHONE**

- A. Refer to Division 1 "General Conditions."
- B. Temporary Electric for Building Construction: Refer to Temporary Facilities for requirements.
- C. Temporary Electric for Construction Trailers: Refer to Temporary Facilities for requirements.
- D. Temporary Telephone for Construction Trailers: Refer to Temporary Facilities for requirements.
- E. Lighting: Provide temporary lighting in accordance with OSHA, (5-footcandles) with local switching to fulfill security requirements and provide illumination for construction operations and traffic conditions.
  - 1. Lamps and Light Fixtures: Provide general service lamps. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

**3.10 UTILITY (POWER) SERVICE DOWN TIME**

- A. Electric service on this project may not be interrupted or down for any period of time during in school use days (by students or staff). All electric service interruptions or down time shall occur during non-school days, on weekends or holidays. All electric service interruptions or down time shall be coordinated with the school district a minimum of two (2) weeks in advance. The Contractor shall include any overtime, night, weekend or holiday pay required to ensure downtime for utility services is kept to a minimum and during periods that the building is not utilized.

**3.11 ELECTRICAL DEMOLITION**

- A. The Electrical Contractor shall be responsible for all electrical demolition.
- B. The Contractor shall be responsible for disconnecting and removing from the site all conduit, wiring, light fixtures, devices, panelboards, transformers, disconnect switches, data, intercom, clock, sound, fire alarm, card access, security, CCTV, etc. The Owner shall tag or notify the Contractor as to any devices, equipment or systems which they wish to salvage before start of each phase of construction. See paragraph, "Salvage" for additional information.



- C. The Electrical Contractor shall review all demolition drawings, including from other trades, and remove from the site all power wiring and associated electrical equipment, including, but not limited to wire, conduit, boxes, disconnecting means, supports, etc. feeding equipment that is being removed by other trades. This includes within the building, on the roof, attached to the building, and on the site.
- D. Where fastened equipment is removed, the contractor shall be responsible to remove the associated lags or bolts that fastened the equipment down. Grind lags or bolts to below existing surface and patch surface to match existing condition.

### 3.12 ELECTRICAL EQUIPMENT IN AND ABOVE CEILINGS

- A. Where ceilings are being removed to accommodate phasing, the contractor shall tie up all low and line voltage wiring that is resting on the ceiling grid scheduled to remain or feeding a later phase until that wire can be removed.
- B. Any wire that is scheduled to remain shall be independently supported from the structure or walls per the applicable specification sections. Low voltage wire shall be installed in cable tray or j-hooks and line voltage wire shall be installed in conduit and supported per NEC.
- C. Where ceilings are being removed to accommodate phasing, the contractor shall tie up all lighting, fire alarm equipment (smoke detectors, annunciation devices, etc.), intercom speakers, and other electrical equipment until the new ceiling is installed. Electrical devices shall be removed or reinstalled as scheduled on the documents.
- D. All existing MC cable encountered above the ceiling, not supported per the NEC, shall be tied up and supported per NEC requirements when encountered.
- E. All wire, conduit, electrical systems or electrical devices, including, but not limited to lighting, power wiring, receptacles, data, fire alarm, security, CCTV, access control, intercom, phone, etc. above or in the ceiling that is abandoned prior to construction or being abandoned as part of the construction shall be removed at no additional cost to the owner. At the completion of the project, there shall be no abandoned wire, conduit, electrical systems or electrical devices in or above the ceiling.

### 3.13 EXISTING SYSTEMS DURING PROJECT

- A. The contractor shall include all wiring, accessories, programming, etc. as required to accommodate the following. The contractor shall be responsible to contact the owner's vendor of each system for the necessary programming, and subsequent decommissioning of the existing systems being removed.
- B. During the construction process, it is the contractor's responsibility to ensure that the building electric and all communications services are maintained during occupied periods. The contractor shall coordinate all downtimes as required per paragraph, "Utility Power Service Down Time." The contractor shall provide temporary prime generation as required utilizing diesel fuel to ensure that the building has electric service while occupied. The contractor shall be responsible to provide a rented generator and the diesel fuel itself at no additional cost to the owner.

- C. During the construction process, it is the contractor's responsibility to ensure that the building life safety and non-life safety emergency systems remain active. The contractor shall provide temporary wiring and possibility additional temporary emergency generator as required to ensure that there is no interruption to the emergency system while the building is occupied outside the construction zone during each phase. It is imperative that the life safety remain active whether the building is occupied or unoccupied to maintain safety for all parties.
- D. During the construction process, it is the contractor's responsibility to ensure that the building fire alarm system remain active. At a minimum, audible and visual devices as well as pull station must remain active within the construction zone. All existing fire alarm devices outside the construction zone shall remain active until the new system is installed. The contractor shall coordinate with the AHJ to verify that it will be acceptable to have two (2) separate systems in the building while the construction progresses; however, the two (2) systems must be tied together so that if one system alarms, they both alarm.
- E. During the construction process, it is the contractor's responsibility to ensure that the building intercommunications system and telephone system remain active. The contractor shall provide temporary wiring and programming as required to ensure that there is no interruption to either system outside the construction zone during each phase.
- F. During the construction process, it is the contractor's responsibility to ensure that the building data network systems remain active. The contractor shall provide temporary backbone and horizontal wiring as required to ensure that there is no interruption outside the construction zone during each phase. The contractor shall coordinate with the owner to ensure the proper wiring is provided on a temporary basis.
- G. All required night, weekend and holiday time required to ensure that the above requirements are met shall be provided at no additional cost to the owner.

### 3.14 SALVAGE

- A. The Owner reserves the right to salvage any electrical equipment prior to the start of each phase of construction.

### 3.15 ELECTRICAL ROOM LAYOUTS

- A. The contractor shall be responsible for submitting electrical room layouts to the engineer prior to any panel or equipment rough ins. Layouts shall show that all equipment will be installed to meet the N.E.C. Code clearance requirements. The Contractor shall bare all costs associated with any changes required if electrical rough-ins are done prior to layout approval.
- B. It shall be the contractor's responsibility to verify all N.E.C. clearance requirements prior to installation, including, but not limited to ductwork, piping, or other equipment above electrical equipment, as well as all horizontal requirements.

END OF SECTION 260010



**SECTION 260030 – ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical connections to equipment specified under other Divisions or furnished by Owner.

**1.2 REFERENCES**

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electric Code.

**1.3 COORDINATION**

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Divisions.
  - 1. Should there be a difference between the design and the installed equipment; change orders shall only be paid for the difference in the rough-ins. If the Division 26 Contractor installs any rough-ins prior to requesting and receiving shop drawings for the equipment to be installed, and the equipment is different than designed, the required rework shall be performed at no additional cost to the owner aside from the difference is cost between the design documents and installed equipment.
  - 2. Should there be a need to install rough-ins ahead of equipment review and final shop drawing, the Division 26 Contractor shall submit a Request for Information, outlining the equipment to be fed, and how the schedule is impacted for review by the Engineer, Architect, Owner and Owner's Representative.
- B. Determined connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

**PART 2 - PRODUCTS**

**2.1 CORDS AND CAPS**

- A. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- B. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- C. Cord Size: Same as rating of branch circuit overcurrent protection.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
- B. The Contractor shall be responsible to coordinate all electrical which are installed for roof top equipment. Refer to "Coordination" in Section 260010 for additional requirements.

**3.2 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

**3.3 ELECTRICAL CONNECTIONS**

- A. Electrical connections shall meet equipment manufacturer's instructions.
- B. Conduit connections to equipment shall use flexible conduit. Liquidtight flexible conduit with watertight connectors shall be used in damp or wet locations.
- C. Wiring connections shall use wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Receptacle outlets shall be used where connection with attachment plug is indicated. Where attachment plug is required, equipment shall have a cord and cap.
- E. Suitable strain-relief clamps and fittings shall be used for cord connections at outlet boxes and equipment connection boxes.
- F. Disconnect switches, controllers, control stations, and control devices shall be located as indicated and per NEC requirements.
- G. Verify proper rotation of three phase equipment.
- H. Where applicable, power wiring shall be extended through external disconnect switches, local control switches, remote mounted control panels, etc. and connected to terminals in the equipment.
- I. Where applicable, wire and conduit shall be extended between control device (start/stop pushbuttons or lighted handle switch) and combination starter/disconnect switches.
- J. Coolers and Freezers: freezer and cooler walls, floors and ceilings shall be cut and sealed around conduit openings.

**3.4 MISCELLANEOUS CONNECTIONS**

- A. Fire alarm, security, data, telephone and other low voltage connections shall be installed as required at equipment.

3.5 CONTRACTOR RESPONSIBILITIES (DIVISION 23 CONTRACT)

A. HVAC Control System Panels

1. 120 volt – 1 phase.
2. Division 23 Contractor shall provide power connection to control panel from nearest 120/208 volt electrical panel. Power for control panels for equipment being fed from the emergency generator, including, but not limited to boilers, heating pumps, selected air handling and terminal equipment, etc., shall be derived from the nearest 120/208 volt normal/emergency panel.
3. Division 26 Contractor shall assist the Division 23 Contractor in locating the appropriate panel, ensure there is a spare 20A/1P breaker to feed the control panels and label breaker accordingly.
4. All wiring associated with the unit shall be by the Division 23 Contractor per manufacturer requirements.

B. Duct-mounted Smoke Detector

1. Division 26 Contractor shall furnish duct mounted smoke detector, including detector base and appropriately sized sampling tube for duct being installed.
2. Division 23 Contractor shall install sampling tube and detector base in duct. Coordinate exact location with Division 26 Contractor.
3. Division 26 Contractor shall install detector in base, wire and program into fire alarm system.
4. Division 26 Contractor shall provide relay, and wiring to associated HVAC unit from fire alarm system so that unit shuts down and supervisory signal is provided upon detection of smoke. Refer to Division 28 "Fire Alarm and Detection System" and drawings for additional requirements.
5. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

C. Ambient Air Cleaner (AAC)

1. 480 volt – 3 phase.
2. Starter to be furnished with the equipment.
3. Fused disconnect switch shall be furnished and installed by the Division 26 Contractor at the unit.
4. Division 26 Contractor to provide control as per drawings.

D. Ductless Air Conditioner (DAC)

1. 208 volt – 1 phase.
2. Thermal overload switch shall be furnished and installed by the Division 26 Contractor adjacent to unit. Provide 1-pole for 120V and 2-pole for 208V units.
3. Division 26 Contractor shall wire through switch and make one power connection to the line side terminals in the unit.
4. Power wire for AC unit shall come from the exterior unit.
5. All other wiring within the unit and between the unit and associated condensing unit shall be by the Division 23 Contractor per manufacturer requirements.

E. Outdoor Packaged Air Handling Units (RTU)

1. 480 volt – 3 phase.
2. All wiring from the input terminals to the respective devices in the unit shall be factory installed by the equipment manufacturer.

3. Starters with overload protection or variable frequency drive(s) for the fans shall be furnished and installed by equipment manufacturer.
  4. Division 26 Contractor shall make one power connections to the unit terminals.
  5. Unit shall be provided NEC approved overcurrent protection and disconnecting means in a unit mounted control panel. Equipment manufacturer shall wire all fans and other equipment from the input terminals.
  6. Equipment manufacturer shall provide control power transformer as required to power controls, unit lighting and convenience outlet and other 120V accessories as required.
  7. All other wiring in the unit shall be factory installed by the equipment manufacturer.
  8. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.
- F. Cabinet Unit Heaters (Electric) (ECH)
1. 120, 277 volt 1-phase, 480 volt – 3 phase.
  2. Fused disconnect switch in unit by equipment manufacturer.
  3. Division 26 Contractor shall make one power connection to the unit.
  4. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.
- G. Air Cooled Condensing Unit (CU)
1. 208 volt – 1 phase
  2. Division 26 contractor shall furnish and install a NEMA 3R fused disconnect switch at unit and shall extend power wiring thru switch to unit and shall make one connection to terminals in unit.
  3. Where CU is associated with an indoor AC, power wire for AC unit shall come from the exterior unit.
  4. All other wiring within the unit and between the unit and associated indoor unit shall be by the Division 23 Contractor per manufacturer requirements.
- H. Dust Collector (DC) Existing
1. Division 26 Contractor to electrically disconnect unit for relocation.
  2. 480 volt – 3 phase
  3. Relocated control panel by Division 23 Contractor.
  4. Division 26 Contractor shall relocate a fused disconnect switch and extend power wiring to the control panel and shall make one power connection.
  5. Division 26 Contractor shall relocate the remote mounted start/stop switch furnished with the unit and shall wire switch to control panel as required.
  6. Dust Switch device with all required Ct's shall be furnished by Division 23 Contractor. Division 26 Contractor shall install device per manufacturer requirements and connect to all devices that are fed by Dust Collector.
  7. Any other connections and/or equipment required shall be provided by Division 23 Contractor.
- I. Smoke Collector (WSC)
1. 480 volt – 3 phase
  2. NEMA 4, 3R factory wired, control panel with integral starters, control transformer and timers shall be furnished and installed by Division 23 Contractor.
  3. Division 23 Contractor shall furnish and install a fused weatherproof disconnect switch in control panel. Division 26 Contractor shall provide single point power wiring to the control panel.

4. Division 26 Contractor shall extend power to exterior blower per manufacturer requirements.
5. Division 26 Contractor shall provide a Nema 3R non fused disconnect switch at exterior blower location and provide power wiring from control panel through NFDS to blower and provide connections.
6. Division 26 Contractor shall install the remote mounted start/stop switch furnished with the unit and shall wire switch to control panel as required.
7. Smoke collector Switch device with all required Ct's shall be furnished by Division 23 Contractor. Division 26 Contractor shall install device per manufacturer requirements and connect to all devices that are fed by Smoke Collector.
8. Any other connections and/or equipment required shall be provided by Division 23 Contractor.

J. Indoor Fans – ATC Controlled (EF)

1. 120 volt – 1 phase.
2. Integral disconnect switch provided by the equipment manufacturer.
3. Thermal overload switch furnished and by the Division 26 Contractor; locate as indicated on drawings.
4. Division 26 Contractor shall install Division 23 Contractor speed control in space being service by fan. Coordinate location in field for balancing.
5. Division 26 Contractor shall make one power connection thru thermal overload switch and speed control where applicable.
6. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.

K. Roof Fans – ATC Controlled (EF)

1. 120 volt – 1 phase.
2. Integral disconnect switch provided by the equipment manufacturer.
3. Division 26 Contractor shall install Division 23 Contractor speed control in space being service by fan. Coordinate location in field for balancing.
4. Division 26 Contractor shall make one power connection through speed control where applicable.
5. Any other connections and/ or equipment required shall be provided by Division 23 Contractor.
6. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

L. Unit Heaters Gas Fired (GUH)

1. 120 volt – 1 phase.
2. Thermal overload switch furnished and installed adjacent to unit by Division 26 Contractor.
3. Any other connections and/or equipment required shall be furnished and installed by the Division 23 Contractor.

3.6 CONTRACTOR RESPONSIBILITIES (DIVISION 22 CONTRACT)

A. Tank Water Heater (Gas)

1. 120 volt – 1 phase.
2. Cord and plug for gas water heater shall be provided by the manufacturer.
3. Division 26 Contractor shall furnish and install a receptacle adjacent unit and connect.
4. Any interconnecting wiring shall be by the Division 22 Contractor.



5. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
- B. Recirculating Pumps
1. 120 volt – 1 phase.
  2. Thermal overload switch (manual starter with thermal protection and hand/auto switch to allow starter control from remote source. Square D class 2510 series with handle guard/lock off attachment mount on or adjacent to equipment) shall be furnished and installed by the Division 26 Contractor. Division 26 Contractor shall install switch adjacent to the unit.
  3. Division 26 Contractor shall run power wiring thru overload switch and make one power connection.
  4. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
- C. Electric Water Cooler
1. 120 volt – 1 phase.
  2. Division 26 Contractor shall refer to Electric Water Cooler shop drawings and furnish and install a duplex receptacle contained within the enclosure where applicable, or provide direct connection where cord and plug is not provided.
  3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
- D. Automatic Wash Fountain / Lavatory sink sensors
1. 120 volt – 1 phase.
  2. Power transformer to be furnished by manufacturer. Division 26 contractor to provide receptacle under sink for transformer. Wiring from transformer to unit by the Division 22 Contractor.
  3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
- E. Automatic Flush Valve Sensors
1. 120 volt – 1 phase.
  2. Power transformer to be furnished by manufacturer. Division 26 Contractor to make a single point connection to transformer above accessible ceiling. Wiring from transformer to unit by the Division 22 Contractor.
  3. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
- F. Air Compressor
1. 480 volt – 3 phase.
  2. Integral factory wired control panel with starter and thermal overloads shall be provided by the manufacturer.
  3. Division 26 Contractor shall provide disconnect at the motor and extend power wiring to terminals in control panel and connect as required.
  4. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.
  5. Provide duplex receptacle adjacent to unit for condensate drain.

G. Air Dryer

1. 120 volt – 1 phase.
2. Factory wired control panel shall with disconnecting means as required.
3. Division 26 Contractor to furnish & install a toggle switch adjacent to unit. Wire thru switch to control panel.
4. Division 26 Contractor shall make one power connection to the control panel.
5. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

H. Sewage Lift Station

1. 480 volt – 3 phase.
2. Factory wired control panel with alternator, combination starters and fused disconnect switches, fused control transformer and all control wiring shall be provided by the Division 22 Contractor.
3. Division 26 Contractor shall make one power connection to the control panel.
4. All control equipment and control wiring associated with this system shall be by the Division 22 Contractor.
5. In addition, the Division 22 Contractor shall connect the power leads (supplied on each motor) to the control panel.
6. Any other connections and/or equipment required shall be furnished and installed by the Division 22 Contractor.

3.7 CONTRACTOR RESPONSIBILITIES (DIVISION 21 CONTRACT)

A. Tamper and Flow Switches

1. Division 21 Contractor shall furnish and install tamper and flow switches, including all ancillary devices associated with the switches.
2. Division 26 contractor shall provide fire alarm system relay and wire device into fire alarm system.
3. Division 26 Contractor shall wire switches into fire alarm system for monitoring.
4. Any other connections and/or equipment required shall be furnished and installed by the Division 21 Contractor.

3.8 CONTRACTOR RESPONSIBILITIES

A. Shop Equipment

1. Division 22, 23 and 26 Contractors shall furnish all equipment shown and/or required to make final connections to the equipment. Where motors and/or equipment are furnished with loose disconnects and/or starters, the Division 26 Contractor shall install the starters, furnish and install the disconnect (if required or indicated) and shall provide power wiring through the starter and disconnect and shall make final connections to the motor. Division 22 and 23 contractors shall be responsible for all piping and duct work connections required.

B. Shop Equipment Demolition

1. Division 22, 23 and 26 Contractors shall be responsible to disconnect all existing welding and 3D Manufacturing equipment in the existing space for removal/relocation by the General Contractor. Division 22, 23, and 26 contractors shall be responsible to reconnect

all existing shop equipment once related to their spaces. All contractors are required to document all existing conditions (piping, ductwork and wiring etc.) of shop equipment to make sure it gets reconnected as was in its original locations.

END OF SECTION 260030

**SECTION 260070 – CONCRETE WORK FOR UTILITIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Work of this section involves cast-in-place concrete construction associated with utilities which includes, but is not limited to, the following:
  - 1. Base slabs.
  - 2. Encasements.
  - 3. Reaction and support blocking.
  - 4. Fillets, benches, and miscellaneous.
  - 5. As indicated on the drawings.

**1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. Pennsylvania Department of Transportation: Publication 408 Specifications.
  - 2. American Society for Testing and Materials (ASTM):
    - a. A615 Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
    - b. C31 Making and Curing Concrete Test Specimens in the Field.
    - c. C39 Test for Compressive Strength of Cylindrical Concrete Specimens.
    - d. C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
    - e. C172 Sampling Fresh Concrete.

**PART 2 - PRODUCTS**

**2.1 CONCRETE**

- A. Ready-mixed, conforming to Section 704, Publication 408 Specifications.
  - 1. Requirements for State approved batch plants, design computations and plant inspection shall not apply. The acceptability of concrete will be based on conformance with the Cement Concrete Criteria specified below and the results of the specified tests.
- B. Concrete Criteria:
  - 1. Concrete for underground ductbanks:
    - a. Minimum 28-day compressive strength: 3000 psi
    - b. Slump: 1 to 3 inches
  - 2. Concrete for all other applications, including, but not limited to light pole bases, transformer vaults, manholes, concrete pads, etc.
    - a. Minimum 28-day compressive strength: 4000 psi
    - b. Slump: 1 to 3 inches

3. Cement Factor and Maximum Water-Cement Ratio conforming to Table A, Section 704.1(b), Publication 408 Specifications.

## 2.2 REINFORCEMENT STEEL

### A. Reinforcement Bars:

1. ASTM A615; Grade 60, deformed billet steel bars, finish conforming to Section 709.1, Publication 408 Specifications.

### B. Welded Steel Wire Fabric:

1. Plain type; unfinished conforming to gage and mesh size as noted on the Drawings and Sections 709.3 and 709.4, PennDOT Publication 408 Specifications.

## PART 3 - EXECUTION

### 3.1 EXECUTION

- A. Comply with Section 1001, PennDOT Publication 408 Specifications for construction requirements including formwork, curing, protection and finishing of cement concrete.
- B. Excavate and shape bottoms and sides of excavation to accommodate thrust block forms, cradles and encasements, manhole bases, and base slabs.
- C. Support conduits and fittings where installed at the required elevation with brick or concrete block. Do not use earth, rock, wood, or organic material as supports.
- D. Construct reaction and support blocking, cradles, encasements, and miscellaneous buried mass concrete of Class A concrete.
- E. Construct base slabs, manhole bases, endwalls, curbs, sidewalks, miscellaneous reinforced structures, and miscellaneous exposed mass concrete of Class AA concrete.
- F. Provide spaces, chairs, bolsters, ties and other devices for properly placing, spacing, supporting and fastening reinforcement in place.
- G. Place concrete utilizing all possible care to prevent displacement of any conduits or fittings. Return displaced conduit or fittings to line and grade immediately.
- H. Ensure tie rods, nuts, bolts and flanges are free and clear of concrete.
- I. Do not backfill structures until concrete has achieved its initial set, forms are removed, and concrete work is inspected by the Architect/Engineer.
- J. Perform backfilling and compaction as specified in Division 26 "Excavation and Backfill for Electrical Utilities."
- K. Provide reinforced steel rebar in ductbank that run under parking or roadways.

3.2 FIELD TESTS OF CONCRETE DURING CONSTRUCTION

- A. Test each 30 cubic yards or fraction thereof of each class of concrete for compressive strength. Retain an independent testing laboratory to test cylinders at the expense of contractor.
  - 1. Sample concrete in accordance with ASTM C172.
  - 2. Prepare and cure two test cylinders in accordance with ASTM C31.
  - 3. Test cylinders in accordance with ASTM C39.
  
- B. If test cylinders fail to meet strength requirements, the Architect/Engineer may require additional core tests in accordance with ASTM C42 at the expense of contractor.

END OF SECTION 260070



## SECTION 260120 – UNDERGROUND ENCLOSURES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Requirements for polymer concrete underground enclosures for use with exterior underground power circuits (i.e., site lighting and receptacle circuits) and other listed applications.

#### 1.2 DEFINITIONS

- A. Enclosures: Refer to box, cover and, if provided, extensions and base.
- B. Box: Upper main section of enclosures containing a recess to receive the cover.
- C. Cover: Top surface section of enclosure for closing top opening of box section.
- D. Knockout: Portion of extension or base with reduced thickness or notched outline-accommodating removal for entrance of cable or conduit.

#### 1.3 GENERAL DESCRIPTION

- A. The polymer concrete underground enclosures are for use in lawn areas. The enclosures shall be suitable for direct buried applications in soil, concrete embedment, or asphalt embedment. The enclosure shall have an ANSI/SCTE 77 2007 Tier 22 Rating unless noted otherwise.
- B. Where applicable, provide enclosures and lids carrying an AASHTO H-20 rating.

#### 1.4 ENVIRONMENTAL TESTS

- A. The enclosures shall comply with all of the environmental tests as per current ANSI/SCTE 77.

#### 1.5 STRUCTURAL REQUIREMENTS

- A. The enclosures shall be current ANSI/SCTE 77 **Tier rating 22**.
- B. The enclosures shall comply with all structural load tests as per current ANSI/SCTE 77.

#### 1.6 SUBMITTALS

- A. Product Data, including cutsheets and installation requirements.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Quazite
- B. Oldcastle equivalents.



- C. Synertech equivalents.

## 2.2 BOX DIMENSIONS

- A. Installed in non-paved or paved areas:

- 1. All underground enclosures:

- a. The box shall be Quazite Tier 22, stackable, open bottom PG series, size as indicated on the drawings. Cover shall be Tier 22 w/ 2 bolt, gasketed, single piece where size allows. Provide "Electric" or "Communications" LOGO Engraved in cover face (the use of metal tags shall not be acceptable). The cover shall be skid resistant. Provide multiple boxes as required to meet depth requirements on the drawings.

## 2.3 ENCLOSURE COLOR

- A. The enclosure shall be concrete/cement grey in color unless otherwise specified.

## PART 3 - INSTALLATION

### 3.1 PREPARATION

- A. Excavate, install base material, and compact base material in accordance with manufacturer's instructions.

### 3.2 INSTALLATION

- A. Installed within paved areas:

- 1. Box cover shall be flush with surrounding ground. Slope ground up to top edge of box to allow proper drainage away from box.
- 2. Boxes installed in pavement shall be provided with 6" x 6" reinforced concrete form around box. Form and place concrete per manufacturer recommendations.

- B. Excavation and Backfill.

- 1. Provide excavation and backfilling. Include minimum 6" gravel Base under the hand hole assembly with the gravel 3" to 4" wider than the sides of the hand hole. (Internal Bracing may be warranted for any manufacturer's underground enclosure if 95% compaction is required or if heavy vehicles are going to be present during construction and/or throughout the life of the enclosure. See manufacturer recommended practices and instruction including applicable sizes that would require internal bracing).

- C. Conduits shall enter pullbox at ends.

- D. Conduits shall turn up in box and be sealed to prevent migration of water. Ensure that the conduit turns up minimum 12" from bottom of box.

END OF SECTION 260120

**SECTION 260500 – COMMON REQUIREMENTS – ELECTRICAL CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes materials and methods that are common to various Electrical Systems.

**1.2 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Fireproofing
  - 2. Access Doors

**1.3 COORDINATION**

- A. Arrange for conduit spaces, chases and openings in building structure during progress of construction to allow for electrical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are construction as applicable.
- C. Coordinate requirements for access panels and doors for electrical items requiring access that are concealed behind finished surfaces.

**PART 2 - PRODUCTS**

**2.1 FIRESTOPPING**

- A. The Contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. For areas that will require future access for the installation of additional cables, repair, or retrofit, the firestopping system shall consist of re-usable intumescent pillows or putty. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
  - 1. Subject to compliance with project requirements, firestopping materials may be provided by one of the following Manufacturers.
    - a. Specified Technologies Inc. (STI) Somerville, NJ (800) 992-1180
    - b. Tremco, Beechwood, OH (800) 321-7906
    - c. 3M, St. Paul, MN (800) 328-1687
  - 2. Submit for review the following product data.
    - a. Product data sheets.
    - b. UL System Drawings for each firestopping application.
    - c. Manufacturer's Certificates of Conformance for their products.

**2.2 ACCESS DOORS**

- A. Refer to Division 8, "Access Doors and Frames" for additional requirements. Access doors furnished and installed under this contractor shall comply with Division 8 requirements in addition to the following.
- B. Manufacturers: Subject to review, provide access doors manufactured by Milcor, Inc or equal.
- C. Description: Steel access doors and frames for installation in masonry and/or drywall/gypsum board assemblies. Provide fire rated access doors when doors are installed in a fire rated assembly.
- D. Frames: minimum 16 gage steel with exposed nominal 1" flange around the perimeter of the unit. Where doors are to be installed in drywall/gypsum board assemblies provide frames with a drywall bead. Doors to be installed in masonry shall be furnished with adjustable metal masonry anchors.
- E. Flush Panel Doors: minimum 14 gage steel with concealed spring or piano hinge(s) with a minimum swing of 175 degrees. Finish to be a factory-applied primer, suitable for field painting. Provide flush cylinder lock with key. Key all locks alike. Verify keying with owner prior to ordering.

**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 -25 for rough-in requirements.

**3.2 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS**

- A. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- B. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

**3.3 FIRESTOPPING**

- A. Comply with manufacturer's written instructions for install fire stopping. When mechanical system is used, set securely in place in accessible locations.
- B. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- C. Firestopping shall be installed in all fire rated walls. Review all drawings, including architectural, and site conditions to determine where fire rated walls are located.

**D. Preparation**

1. **Surface Cleaning:** Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - a. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
  - b. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  - c. Remove laitance and form-release agents from concrete.

**E. Installation**

1. **General:** Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
2. 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.
  - a. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
3. Install fill materials by proven techniques to produce the following results:
  - a. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - b. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - c. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

**F. Identification**

1. **Wall Identification:** Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
2. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

**G. Cleaning and Protection**

1. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
2. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.4 ACCESS DOORS

- A. Comply with manufacturer's written instructions for installing access doors and frames. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces. Install doors flush with adjacent finished surfaces or recessed to receive finish material.
- B. Adjust doors and hardware after installation for proper operation. Remove and replace doors and frames that are warped, bowed or otherwise damaged.

END OF SECTION 260500

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SECTION 260519 – WIRES AND CABLES – 600V AND BELOW

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the wire and cable work is indicated by Drawings and by requirements or other sections of the Specifications for cables used for power, lighting, signal, control and related system rated 600 volts or less. **See below article “CABLES” for permitted use of Type MC Cables on this project.**

1.2 CODES AND STANDARDS

- A. NEC Compliance: Comply with applicable requirements of NEC for construction and installation of wires/cables and connectors.
- B. UL Compliance: Comply with UL Stds 44, 83 and 486A, B and C. Provide wiring/cabling and connector products which are UL-listed and labeled consistent with their uses.
- C. ICEA Compliance: Insulated Cable Engineers Association Inc., Standard WC-5-86.
- D. IEEE Compliance: Institute of Electrical and Electronic Engineers, Standard 82-83.

1.3 SUBMITTALS

- A. Provide submittals for compression lugs only; wire does not require submittal.
- B. Comply with Division 1 requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all wires and cables of sizes indicated on the Drawings and suitable for the temperature, conditions and location where installed. Install all wire in raceway.

2.2 CONDUCTOR MATERIAL

- A. Use copper conductors of 98% conductivity and rated at 600V for all wires and cables, unless otherwise noted.

**1. All device and equipment feeds shall be copper unless specifically noted otherwise.**

2.3 INSULATION

- A. No conductors smaller than No. 12 AWG shall be used unless noted elsewhere. All wires No. 8 AWG or larger shall be stranded. Wire sizes No. 12 and No. 10 AWG. shall be solid (**stranded wire used for No. 12 AND 10 will not be permitted unless otherwise noted**).

- B. All conductors shall be provided with type THHN/THWN insulation, unless noted otherwise.
- C. All switchboard, transformer and panelboard feeder insulation shall be type XHHW-2.
- D. Each circuit shall be provided with a dedicated neutral wire. Sharing of neutral wire for multiple circuits shall not be permitted, unless otherwise noted.

## 2.4 CABLES

- A. Provide the following in NEC approved locations and project applications where indicated.
- B. Type MC Cable: Provide Metal Clad Cable wiring using two No. 12 or 10 AWG with separate insulated copper ground wire (unless noted otherwise). Where AC (armored cable without separate neutral) is installed, Contractor will be required to remove cable and reinstall with approved cable type at no additional cost to the owner. Metal Clad cable may be used on this project only as follows:
  - 1. For lighting and receptacle branch circuits from panel to device(s) or light fixture(s). MC cable permitted above ceilings only. All wiring run in exposed structures shall be run in conduit.
  - 2. Connection to motors (2 feet maximum).
  - 3. Fishing existing walls.
  - 4. Branch circuits in stud walls.
- C. Where MC cables are run in parallel (i.e., down corridors above ceilings), the Contractor shall bundle the cables and zip tie them together.
- D. The Contractor shall bear all costs related for removing MC cable not pre-approved. Support and secure type MC cable at intervals not exceeding 6'-0". In addition, type MC cable must be supported within 12" of every fitting, junction box or outlet box that the cable enters.
- E. All other wiring shall be installed in conduit as specified in Division 26 "Raceways," unless approved otherwise by the Engineer prior to installation.
- F. All transformer and panelboard feeder wiring shall be run in conduit.

## 2.5 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

## PART 3 - EXECUTION

### 3.1 WIRES AND CABLES

- A. General: Install electrical cables, wires, and connectors in compliance with NEC. Coordinate cable installation with other work. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- B. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

- C. **While installing cables, care shall be taken to protect outer coating. If outer coating is damaged, contractor shall remove and reinstall cables.**
- D. Conceal all cable in finished spaces. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible. Keep conductor splices to minimum.
- E. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor material.
- F. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal. Provide wire ties and neatly train and rack wires in all boxes, panels, and other areas as required.
- G. Tighten electrical connectors and terminals, including screws and bolts, in accordance with Manufacturer's published torque tightening values. Where Manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.
- H. Each branch circuit shall be provided with a dedicated neutral wire, unless noted otherwise.
- I. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.2 FIELD QUALITY CONTROL

- A. Prior to energizing, provide the following tests to all cables, 600 Volt or less and size no. 3 AWG or larger:
  - 1. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
  - 2. Test bolted connections for high resistance using one of the following:
    - a. A low-resistance ohmmeter.
    - b. Calibrated torque wrench.
    - c. Thermographic survey.
  - 3. Inspect compression-applied connectors for correct cable match and indentation.
  - 4. Inspect for correct identification.
  - 5. Inspect cable jacket and condition.
  - 6. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration. Use an industry approved meter for all tests.
  - 7. Continuity test on each conductor and cable.
  - 8. Uniform resistance of parallel conductors.
  - 9. All inspection, cleaning and testing procedures shall be in compliance with the recommendations and standards outlined in the "maintenance testing specifications for electrical power distribution equipment and systems", latest edition, published by International Electrical Testing Association (NETA).
- B. Prepare test and inspection reports and locate in the O&M manuals at the completion of the project. Test and inspection reports shall be provided to record the following:
  - 1. Procedures used.



2. Results of above tests that comply with requirements.
  3. Results that do not apply, corrective action taken, and retesting showing that they comply with the above requirements.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- D. Color-Coding for Phase Identification:
1. Color-code secondary service, feeder, and branch circuit conductors with factory-applied color as follows:

Phase	120/208 Volts	120/240 Volts	277/480 Volts
A	Black	Black	Brown
B	Red	Orange (High-Leg)	Orange
C	Blue	Blue	Yellow
Traveler	Yellow	Yellow	Yellow w/ "T" tag
Neutral	White	White	Gray
Ground	Green	Green	Green w/ Yellow stripe
  2. Switch legs shall include an additional "S" tag.
  3. Provide visible colored taped as listed above at all termination points for No. 8 and larger wires.

END OF SECTION 260519

**SECTION 260526 – GROUNDING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Extent of electrical grounding and bonding work is indicated by Drawings and Schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
- B. Type of electrical grounding and bonding work specified in this section includes the following:
  - 1. Solidly grounded.

**1.2 CODES AND STANDARDS**

- A. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
- B. UL Compliance: Comply with applicable requirements of UL 467, 486A, and 869, pertaining to grounding and bonding of systems, circuits and equipment. Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
- C. NRTL: Connectors shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND COMPONENTS**

- A. General: Except as otherwise indicated, provide electrical grounding and bonding system assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.
- B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sizes according to NEC.
- C. Bonding Plates, connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by bonding plate, connector, terminal and clamp Manufacturers for indicated applications.
- D. Ground Electrodes and Plates:
  - 1. Grounding Electrodes: Solid copper, 5/8" diameter by 10 feet.
  - 2. Grounding Electrodes: Steel with copper welded exterior, 3/4" diameter by 10 feet.

- E. Electrical Grounding connection Accessories: Provide electrical insulating tape, heat shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories Manufacturers for type service indicated.
- F. Direct Burial Compression Grounding System similar to Panduit's Structural Ground "Direct Burial Compression Grounding System" shall also be acceptable where exothermic connections are specified. Direct Burial System shall meet IEEE Standard 837-2002. System shall also meet UL 467. Contractor shall be responsible for providing all Grounding plates, connectors, cables, hydraulic crimping tool, etc. for a complete system. All other Direct Burial Grounding system manufacturers shall be submitted for approval prior to bidding.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Architect/Engineer 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 ELECTRICAL GROUNDING AND BONDING SYSTEM

- A. General: Install electrical grounding and bonding system as indicated, in accordance with Manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
- C. Branch Circuits: Install a minimum 12 AWG ground wire in each 20A circuit and conduit run and to connect to each device. Size larger circuit ground wires as per NEC Table 250-122.
- D. Exothermically weld grounding conductors to underground grounding electrodes.
- E. Ground electrical service system neutral at service entrance equipment to grounding electrodes per NEC Article 250. Grounding conductor shall be 4/0 copper, unless otherwise noted.
- F. Direct burial compression grounding system similar to T&B and Panduit shall also be acceptable. System shall meet IEEE Standard 837-2002. System shall meet UL.
- G. Ground each separately-derived system neutral to separate grounding electrode.
- H. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- I. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus, or bushing.
- J. Connect grounding electrode conductors to copper electrodes as per N.E.C., building steel and 1" diameter, or greater, metallic cold-water pipe using a suitably sized ground clamp. Provide

grounding electrode connection to concrete slab rebar to meet NEC. Provide 4/0 copper conductor for all connections.

- K. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with Manufacturer's published torque tightening values for connectors and bolts. Where Manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- L. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.
- M. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory-applied protective coatings have been destroyed, which are subjected to corrosive action.
- N. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- O. Provide ground wire connection to all electrical boxes and wiring devices.
- P. Provide #6 AWG copper ground conductor connection to all cable trays. Cable tray grounding shall be continuous.
- Q. Provide minimum #6 AWG ground connection from transformer to building steel. Provide larger conductor as required per NEC and drawings.
- R. Bond service ground conduit to grounding conductor if conduit is metallic.
- S. The contractor shall be responsible to provide grounding connection on gas piping where an appliance or mechanical piece of equipment has gas and electric circuit run to it. The ground conductor size shall be the same size as the electrical branch circuit run to the appliance or equipment to meet the NEC. article 250.
- T. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping. Connect with same size ground as ground feeding circuit.
- U. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- V. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance of each separately derived system with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.
  - 1. Provide type-written report in O&M manual documenting test results.
- B. Contractor shall coordinate with local inspector to provide tests as required, and provide additional tests as required.

END OF SECTION 260526

**SECTION 260529 – SUPPORTING DEVICES**

**PART 1 - GENERAL**

**1.1 CODES AND STANDARDS**

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical supporting devices.
- B. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
- C. UL Compliance: Provide electrical components and devices which are UL-listed and labeled.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one (1) type of device fulfills indicated requirements, selection is Installer's option.

**2.2 SUPPORTS**

- A. Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
  - 1. Clevis Hangers: For supporting up to 2" rigid metal conduit; galvanized steel; with 2" diameter hole for round steel rod; approximately 54 pounds per 100 units.
  - 2. Riser Clamps: For supporting up to 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears; approximately 510 pounds per 100 units.
  - 3. Reducing Couplings: Steel rod reducing coupling, 2" x 5/8", black steel; approximately 16 pounds per 100 units.
  - 4. C-Clamps: Black malleable iron; 2" rod size; approximately 70 pounds per 100 units.
  - 5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flanges width 2"; approximately 52 pounds per 100 units.
  - 6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
  - 7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
  - 8. Hexagon Nuts: For 2" rod size; galvanized steel; approximately 4 pounds per 100 units.
  - 9. Round Steel Rod: Black steel; 2" diameter; approximately 67 pounds per 100 feet.
  - 10. Offset conduit clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

**2.3 ANCHORS**

- A. Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Lead Expansion Anchors: 2"; approximately 38 pounds per 100 units.
2. Toggle Bolts: Spring head; 3/16" x 4"; approximately 5 pounds per 100 units.
3. Manufacturers: Provide anchors of one of the following (for each type of anchor):
  - a. Ackerman Johnson Fastening Systems, Inc.
  - b. Ideal Industries, Inc.
  - c. Joslyn Manufacturing and Supply Co.
  - d. McGraw Edison Co.

#### 2.4 SLEEVES AND SEALS

- A. Provide sleeves and seals, including armored cable seals, of types, sizes, and materials indicated, with the following construction features:
  1. Sleeve Seals: Provide sleeves for piping which penetrated foundation walls below grade, or exterior walls. Caulk between sleeve and pipe with non-toxic, UL-classified caulking material to ensure watertight seal.
  2. Wall and Floor Seals: Provide watertight wall and floor seals, or types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- B. Fire-Rated Walls and Floors: At all locations where conduits, cables, or ducts penetrate a fire-rated wall or floor, a special fire-retardant caulking compound or other approved device as specified in Division 26 "Common Requirements - Electrical" shall be used.

#### 2.5 CONDUIT CABLE SUPPORTS

- A. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable-iron casting with hot-dip galvanized finish.

#### 2.6 U-CHANNEL STRUT SYSTEMS

- A. Provide U-channel strut system for supporting equipment supplied under this contract, 12-ga hot-dip galvanized steel, or types and sizes indicated; construct with 9/16" diameter holes, 8" on center on top surface, with standard green finish, and with the fittings which mate and match with U-channel. The Contractor is responsible to size and install strut to meet properly support its intended load.
- B. Auxiliary Steel Supports: Provide all required auxiliary steel to install any equipment supplied under this contract. The design and gauge of steel used shall be as required by the manufacturer's specifications. The Contractor is responsible to size and install auxiliary steel to properly support its intended load.
- C. Drop Cords: At Drop Cord locations provide miscellaneous threaded rod, unistrut, steel plates, etc. to vertically and laterally support Drop Cord. Where drop cord is located in ceilings provide proper support to prevent movement and damage to ceiling tile.
- D. Manufacturers: Provide U-channel strut systems of one of the following (for each type system):
  1. Allied Tube and Conduit Corp.
  2. Midland-Ross Corp.

3. OZ/Gedney Div; General Signal Corp.
4. Power-Strut Div; Van Huffel Tube Corp.
5. Unistrut Div; GTE Products Corp.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices. Comply with installation requirements of NECA and NEC pertaining to supporting devices.
- B. Coordinate with other mechanical and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Where supports or anchors are installed after the spray on insulation and/or firestopping is installed, patch the spray on insulation and/or firestopping to match surrounding area.

END OF SECTION 260529





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SECTION 260533 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the raceway and work required by this section is indicated by Drawings and requirements of other sections of this Specification.
- B. Provide metal and nonmetallic conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated on plans. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.
- C. It is the intent of these Specifications and Drawings that all feeder wiring be run in a continuous conduit system. **EMT conduit shall be used for all feeders/circuits for interior exposed spaces. Schedule 40 PVC conduits shall be used underground (concrete encased where noted). All elbows for underground conduit shall be Large radius rigid galvanized steel. Exposed exterior conduits shall be rigid galvanized steel (example: exterior walls) to provide additional protection against damage.** Type MC cables are permitted for lighting and power, branch circuits above ceilings and in stud walls, fishing existing walls, and connection to equipment/motors (2 feet max). In areas of exposed structure all wiring shall be run in conduit. At all locations where MC cable cannot be fished in an existing wall, surface (nonmetallic or metallic as specified) raceway shall be used. Finish of raceway shall be verified with the Architect before ordering. Surface raceway shall be screwed into the surface being installed at both ends and every 24" minimum along raceway. All surface raceway shall be run parallel and perpendicular to wall surfaces and run to blend in with surrounding equipment. Type MC Cables are not permitted to be installed in exposed structure spaces.
- D. Refer to Division 26, "Wires and Cables – 600V and Below" for acceptable uses of MC cables.

1.2 CODES AND STANDARDS

- A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to electrical raceway systems; provide products and components which have been UL-listed and labeled.
- C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of raceway systems.

PART 2 - PRODUCTS

2.1 CONDUITS

- A. Rigid Steel Conduit: Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6. Provide zinc-coating fused to inside and outside walls.

- B. Rigid Aluminum Conduit: Provide rigid aluminum, threaded type conforming to ANSI and UL standards.
- C. Intermediate Steel Conduit: Provide rigid intermediate grade (IMC) hot-dip galvanized threaded conforming to FS WW-C-581 and UL 1242.
- D. Electrical Metallic Tubing (EMT): FSW-C-563, ANSI C80.3, and UL 797.
- E. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- F. Flexible Metal Conduit: FS WW-C-566 and UL 1. Formed from continuous length of spirally wound, interlocked zinc-coated strip steel.
- G. PVC Heavy Wall Conduit: Schedule 40, 90C, UL-rated, constructed of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, UL-listed and in conformity with NEC Article 347. PVC conduit may only be installed above finished grade, where specifically indicated on the drawings or within the specifications.
- H. PVC Light Wall Conduit shall not be acceptable under any circumstances. PVC Heavy Wall conduit shall be used when encased in concrete.
- I. No other type of conduit shall be used, unless otherwise noted, or prior approval granted by the engineer.

## 2.2 CONDUIT FITTINGS

- A. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.
- B. Straight Terminal Connectors: Contractor shall provide one-piece body, with female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- C. 45-Deg or 90-Deg Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- D. Rigid Metal Conduit Fittings: Cast-malleable-iron, galvanized or cadmium plated, conforming to FS W-F-408. Use Type 1 fittings for raintight connections, Type 2 fittings for concrete tight connections, and Type 3 fittings for other miscellaneous connections.
- E. Rigid Aluminum Conduit Fittings: Provide cast-aluminum conduit fittings and mounting hardware conforming to ANSI and UL standards of types required for the application.
- F. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G. Provide cadmium-plated, malleable-iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or non-insulated throat.
- G. EMT Fittings: All couplings and connectors shall be of the compression type.
- H. PVC Heavy Wall Conduit and Tubing Fittings: Mate and match to conduit or tubing type and material.

- I. Conduit and Tubing Accessories: Provide conduit, tubing and duct accessories of types, sizes, and materials, complying with Manufacturers' published product information, which mate and match conduit and tubing.
- J. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes, and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit entrance ends, removable covers, either cast or galvanized steel, and corrosion-resistant screws.
- K. MC Fittings: The Snap2It connector with insulated throat as manufactured by Arlington may be used for MC cable connectors in lieu of the traditional cast fitting. However, these fittings may not be used for any other application.
- L. All raceway conduit and fittings above a ceiling shall be plenum rated.
- M. Press type fittings may not be used unless specifically specified to be acceptable elsewhere in the specifications or on the drawings.

### 2.3 WIREWAYS

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other components and accessories as required for complete system.
- B. Lay-In Wireways: Provide lay-in wireways with hinged covers, in accordance with UL 870 and with components UL-listed, including lengths, connectors and fittings. Design units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.
- C. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.
- D. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.
- E. Raintight Troughs: Construct in accordance with UL 870, with components UL listed.
- F. Construction: 16-ga galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14-ga parts for 8" x 8" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate or tear during installation, or would compromise raintight capability of the trough. Do not use cover screws that will protrude into the trough area and damage wire insulation.
- G. Finish: Provide 14-ga and 16-ga galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

### 2.4 SURFACE RACEWAY

- A. Provide single or dual channel surface raceway as specified on the drawings. Unless noted otherwise, raceway finish shall be selected at shop drawings from full list of standard and premium finishes.

- B. Device plates matching the raceway system shall be utilized. Standard wall mounted device plates shall not be acceptable.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Low voltage wiring in walls must be run in conduit system rated for 600V, as specified above. the use of flexible innerduct material in walls shall not be acceptable, unless specifically specified elsewhere. In new construction, conduits shall be rigid of appropriate type for the installation. In existing construction, flexible metallic conduit shall be used.
- B. Unless noted otherwise, all conduit shall be installed concealed in walls, under slabs, or above ceilings.
- C. Type MC cables shall be permitted only as noted.
- D. Unless noted otherwise, raceways and cables shall be installed near the structure and be supported independently from the structure. Support systems for other building systems (i.e. ductwork, HVAC equipment, system piping, ceiling supports, etc.) shall not be used to support conduits and cables. When routed from light fixtures and other system connections, raceways and cables shall be routed directly vertical to structure and across. Drop wire supports shall not be used on any ceiling support wires under any circumstances.
- E. Use PVC Schedule 40 conduit where circuits, feeders and service conductors are embedded in concrete, masonry, or earth, and use rigid galvanized steel elbows with large sweep elbows wherever turns are needed (**do not use PVC elbows**). Where PVC conduit is installed below finished floor level within the building pad, contractor shall transition to IMC or rigid galvanized steel at the elbow and rise to above floor slab. Where PVC conduit is used exterior to the building under finished grade, contractor shall transition to galvanized rigid steel conduit at the elbow up, and continue using galvanized rigid steel along the riser to above finished grade.
- F. PVC Schedule 40 conduit may be run in CMU wall cavities when originating from below finished grade and terminating at a recessed box no higher than 48" above finished floor or grade. For all other installations within wall cavities, PVC conduit shall not be used.
- G. Use rigid aluminum conduit where installed exposed outdoors.
- H. Use EMT conduit in mechanical equipment rooms, electrical equipment rooms, penthouses, crawl spaces, walls, and areas above ceiling.
- I. Use flexible metal conduit in moveable partitions and from outlet boxes to recessed lighting fixtures, and final 24" of connection to motors, or control items subject to movement or vibration, and in cells of precast concrete panels. Conduit size shall be increased as required to fit wiring per NEC.
- J. Use liquid-tight flexible metal conduit in mechanical spaces. Conduit size shall be increased as required to fit wiring per NEC.
- K. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
- L. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameters.

- M. Size conduits to meet NEC, except no conduit shall be smaller than 3/4" on this project.
- N. Fasten conduit terminations in sheet metal enclosures by two locknuts, and terminate with bushing. Install locknuts inside and outside enclosure. **Metallic insulating conduit bushings shall be used on all power conduits.** Split bushings shall **not** be acceptable.
- O. Conduits are not to cross pipe shafts or ventilating duct openings.
- P. Keep conduits a minimum distance of 6" from parallel runs of hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
- Q. Support riser conduit at each floor level with clamp hangers.
- R. Use of running threads at conduit joints and terminations is prohibited.
- S. Where required, use 3-piece union or split coupling.
- T. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- U. For concrete floors-on-grade, install PVC Schedule 40 conduits under concrete slabs.
- V. Install underground conduits minimum of 24" below finished grade.
- W. Install conduits so as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
- X. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.
- Y. **Conduits shall not be installed against roof deck. Allow minimum 3" space between top conduit and roof deck for the possible penetration of roof nails to protrude without damaging conduit.**
- Z. In finished spaces without ceilings (i.e. gymnasiums, natatoriums, etc.), conduits shall be installed as high as possible, while meeting other requirements within these specifications. Conduits along bottom cord of open joists shall not be acceptable. Where conduits need to be installed along bottom of joists or beams, they shall be installed against walls.
- AA. Provide fish wire or pull string in all spare conduits.
- BB. Cap all spare conduits installed for future use.
- CC. Install surface metal raceways in corners or walls or conceal as much as possible.
- DD. There shall be no more than three (3) 20A branch circuits installed in a single 3/4" conduit. Each circuit shall be provided with a dedicated neutral wire. Sharing of neutral wire for multiple circuits will not be permitted.
- EE. At locations where conduits are installed after painting is done, the contractor shall be responsible to go back and paint conduit and boxes same color to match.
- FF. Metallic and non-metallic raceway shall be mechanically fastened to surfaces at intervals as recommended by the manufacturer. Under no circumstances shall glue, two-sided tape, or other type of adhesive be the only means of attachment.

- GG. For exterior wall or foundation penetrations, seal around conduits/sleeves and annular space between sleeve and conduits to limit water migration.
1. Select seal material to fit the installation location, and ensures no degradation of the sealing material over time due to environmental conditions including, but not limited to continuous ground or rain water, solar impact, temperature changes, freezing, etc. Where exposed, sealing compound shall match adjacent surfaces in texture and color.
- HH. Installation through walls:
1. Where conduits are installed to pass through existing walls, the wall shall be cored to allow the conduit to be installed through the wall, and fire calk installed around the conduit.
  2. Where MC cable is installed through a wall, an EMT sleeve of sufficient size to fit all of the MC cables shall be installed through a core in the wall, fire calk installed around the sleeve, and fire putty installed around the MC cables.
  3. Should the contractor break out blocks, or cut an opening in the wall, not using a properly sized hole saw, he shall provide an appropriately sized lintel to maintain structural integrity of the wall, patch the wall by toothing in new block, new drywall sheet, or other means matching the wall material, and provide fire calk around the conduit or sleeve in the opening.

### 3.2 CONDUITS IN CONCRETE SLABS

- A. Conduits installed in concrete slabs will not be permitted. PVC conduits shall be installed under concrete slabs in stone base minimum 4" below to top of conduit.
- B. Conduits installed in elevated slabs will not be permitted. Conduits shall be installed in ceiling plenum spaces below elevated slabs.

### 3.3 EXPOSED CONDUITS

- A. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
- B. Install exposed conduit work as not to interfere with ceiling inserts, lights, or ventilation ducts or outlets.
- C. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed following: Up to 1": 6'-0"; 1-1/4" and over: 8'-0".
- D. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
- E. Cap all spare and active conduits stubbed up from the floor with secure PVC caps. Caps used for active conduits shall be notched to accommodate the quantity and size of cables installed in each conduit.
- F. Where possible, exposed conduits shall be run along walls and at 3" from roof deck. Care shall be given to avoid creating a ledge of conduits along bottom of steel.
- G. Where exposed conduits are installed outside of spaces labeled as electrical or mechanical, they shall be prepped and painted with appropriate products to match adjacent surfaces, unless specifically stated, in writing, by the architect/engineer/owner that they may remain unfinished.

3.4 NON-METALLIC CONDUITS

- A. Make solvent cemented joints in accordance with recommendations of Manufacturer.
- B. Install PVC conduits in accordance with NEC and in compliance with local utility practices. Provide expansion joints as required by Manufacturer and NEC.

3.5 CONDUIT FITTINGS

- A. Construct locknuts for securing conduit to metal enclosure with sharp edges for digging into metal, and ridged outside circumference for proper fastening.
- B. Bushings for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
- C. Install insulated type bushings for terminating conduits 1-1/4" and larger.
- D. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
- E. Bushing of standard or insulated type to have screw type grounding terminal.
- F. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.

3.6 RACEWAYS AND WIREWAYS

- A. Avoid use of dissimilar metals through system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
- B. Install expansion fittings in all raceways/wireways wherever structural expansion joints are crossed.
- C. Make changes in direction to raceway/wireway run with proper fittings, supplied by raceway Manufacturer. No field bends of raceway/wireway sections will be permitted.
- D. Properly support and anchor raceways/wireways for their entire length by structural materials. Raceways are not to span any space unsupported.
- E. Use boxes as supplied by Manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., shall not be permitted for use with surface installations.

END OF SECTION 260533





**SECTION 260535 – ELECTRICAL BOXES AND FITTINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. The extent of electrical box and associated fittings work is indicated by Drawings and Schedules.

**1.2 CODES AND STANDARDS**

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- B. UL Compliance: Comply with UL Std No.'s 50, 514-series and 886. Provide electrical boxes and fittings which are UL-listed and labeled.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and Pub 250.

**PART 2 - PRODUCTS**

**2.1 FABRICATED MATERIALS**

- A. Outlet Boxes: Provide galvanized coated flat-rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated (or as required), suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding. Flush boxes must be mounted flush with finished wall surface.
- B. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliant option.
- C. Device Boxes: Provide galvanized coated flat-rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated (or as required), suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cables clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding. Flush boxes must be mounted flush with finished wall plate.
- D. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's codes-compliant option.

- E. Surface-Mounted Device and Outlet Boxes: Provide a minimum depth galvanized-coated steel box where indicated on the Drawings, without pre-punched knockouts.
- F. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, including face plate gaskets and corrosion-resistant plugs and fasteners. Provide raintight outlet boxes where installed outside, and within moisture rich environments (showers, locker areas, natatoriums, etc.)
- G. Junction and Pull Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers. Provide handles on covers over 4 square feet.
- H. Where surface or recessed boxes are indicated to be blank or with wire leads for future use, they shall be provided with blank covers per Division 26 "Wiring Devices".
- I. All boxes shall be metallic, unless noted otherwise.
- J. Under no circumstances shall low voltage rings be used on the project. All outlet boxes used for low voltage system including, but not limited to tele/data, controls, A/V wiring, etc. shall be fully enclosed device boxes, rated for 600V wiring as specified above.**

### PART 3 - INSTALLATION

#### 3.1 GENERAL

- A. Install electrical boxes and fittings as indicated, in accordance with Manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. When installed in stud walls (wood or steel), electrical boxes shall be installed in walls, supported from both sides, bridged between studs, the use of cantilevered supports shall be unacceptable.
- C. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- D. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
- E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- F. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- G. Position recessed outlet boxes accurately to allow for surface finish thickness.
- H. Where devices are shown at casework, contractor shall coordinate exact location and height with casework to ensure usability of devices.
- I. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.
- J. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

- K. Provide electrical connections for installed boxes.
- L. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- M. Ground electrical boxes properly upon completion of installation work and demonstrate compliance with requirements. Ground electrical box and wiring device.

**3.2 INSTALLATION TO MEET ACOUSTICAL PERFORMANCE**

- A. In order to reduce sound transmission through walls, when back boxes are installed to serve both sides of the wall, they shall be installed in different stud cavities. Where boxes are found to be installed in the same stud cavity, feeding two different sides of the wall, they will be required to be removed and reinstalled at the contractor's expense.

END OF SECTION 260535



**SECTION 260553 – ELECTRICAL IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 CODES AND STANDARDS**

- A. UL Compliance: Comply with UL Std 969.
- B. NEC and NEMA Compliances: Comply with NEC and NEMA WC-1 and WC-2.
- C. ANSI Compliance: Comply with ANSI Std A13.1.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Except as otherwise indicated, provide Manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is installer's option, but provide single selection for each application.
- B. The Electrical Identification, as outlined in this specification, shall be provided in addition to the labeling requirements listed in other specification sections.

**2.2 UNDERGROUND-TYPE PLASTIC LINE MARKER**

- A. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
  - 1. Provide line marker with detectable metallic core for installation above primary power, secondary power and communications service ductbanks.
  - 2. Provide standard plastic line markers for all other installations.

**2.3 CABLE/CONDUCTOR IDENTIFICATION BANDS**

- A. Provide Manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type; either pre-numbered plastic-coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

**2.4 SELF-ADHESIVE PLASTIC SIGNS**

- A. Provide Manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application areas and adequate for visibility, with proper wording for each application (e.g., "EXHAUST FAN FED FROM PANEL PD1").
- B. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

**2.5 ENGRAVED PLASTIC-LAMINATE SIGNS**

- A. Provide engraving stock melamine plastic laminate with black face and white core plies (letter color), complying with FS L-P-387, in sizes and thicknesses indicated. Engrave laminate with engraver's standard letter style of sizes and wording indicated, and punch for mechanical fastening except where adhesive mounting is necessary because of substrates.
- B. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

**2.6 LETTERING AND GRAPHICS**

- A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by Manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

**2.7 MANUFACTURERS**

- A. Provide electrical identification products of one of the following (for each type marker):
  - 1. Ideal Industries, Inc.
  - 2. LEM Products, Inc.
  - 3. Markal Company
  - 4. National Band and Tag Co.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Install electrical identification products as indicated, in accordance with Manufacturer's written instructions, and requirements of NEC.

**3.2 COORDINATION**

- A. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

**3.3 REGULATIONS**

- A. Comply with governing regulations and requests of governing authorities for identification of electrical work.

**3.4 UNDERGROUND CABLE IDENTIFICATION**

- A. During backfilling/topsoiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
- B. Install line marker for every buried cable, regardless of whether direct-buried or protected in conduit.

**3.5 CABLE/CONDUCTOR IDENTIFICATION**

- A. Apply cable-conductor identification where wires of communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, Contract Documents, and similar previously established identification for project's electrical work.
- B. Install engraved plastic-laminate tags on new power cables in all manholes and in pullboxes to identify over current device number. Use tie wraps to attach tag to cables. The nameplate shall bear the following information: Building served; voltage, cable size, class of insulation, phase designation.

**3.6 DANGER SIGNS**

- A. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
- B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
- C. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

**3.7 ARC FLASH LABELS**

- A. Provide arc flash labels on equipment per NEC and NFPA. Labels shall be placed in a prominent position that is clearly visible before access to a dangerous area is reached. This includes the front of devices similar to disconnect switches, motor starters, switchboards, etc. and just inside the front cover of panelboards. The labels shall be of sufficient durability to withstand the environment involved.
- B. Provide signs for each unit of the following categories of electrical work.
  - 1. Panelboards, electrical cabinets and enclosures.
  - 2. Combination starter / disconnect switches.
  - 3. Power transfer equipment.
  - 4. Disconnect switches.
  - 5. Transformers.
  - 6. Low Voltage Lighting Control Panels.



**3.8 SERVICE ENTRANCE FAULT CURRENT LABELS**

- A. Provide label at service entrance equipment (switchboard, distribution panelboard, etc.) The label shall be of sufficient durability to withstand the environment involved. The label shall indicate the following information per NEC and NFPA:
1. Nominal system voltage.
  2. Maximum available fault current.
  3. Clearing time of service overcurrent protective device(s) based on the available fault current.
  4. The date the label was applied.

**3.9 EQUIPMENT/SYSTEM IDENTIFICATION**

- A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), White lettering in Black field. Provide text matching terminology and numbering of the Contract Documents and shop drawings. Each listed piece of equipment below shall have a sign that has the following: 1. Equipment Name, 2. Where the equipment is fed from. Example: PANEL "PD1" (FED FROM PANEL DPD).
- B. Provide signs for each unit of the following categories of electrical work.
1. Panelboards, electrical cabinets and enclosures.
  2. Combination starter/disconnect switches.
  3. Disconnect switches.
  4. Transformers.
  5. Low Voltage Lighting Control Panels.
- C. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

**3.10 DIRECTORIES**

- A. Provide typed circuit directory cards in all panelboards (both breaker and fuse type) and low voltage lighting control panels indicating the room number or area, and the item or items controlled by each circuit. Provide typed circuit directory cards for all "Existing" panelboards where the Contractor has added, deleted or moved circuits with in an "Existing" panelboard.
- B. Switchboards shall be provided with plastic-laminate tags similar to those specified in under "Equipment/System Identification". The tags shall indicate what the circuit feeds and the location of the device.
- C. Directories shall use actual room numbers to indicate locations of all devices, including, but not limited to receptacles, lighting, mechanical equipment, etc. When preparing schedule, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, request, in writing, a schedule to reflect the proper room numbers.

- D. Provide sufficient information to meet requirements of Article 408 of the National Electric Code. Specifically, location of device fed shall be added to directory cards.

3.11 ADDITIONAL FUSE LABELING

- A. At the exterior enclosure of all fused switches, provide additional labeling designating fuse sizes, types and quantity.

3.12 EMERGENCY POWER SOURCE NOTIFICATION

- A. Provide a sign at the main service location indicating type and location of emergency power source in accordance with the requirements of Section 700-8 of the National Electrical Code.  
**Label Panel WSNE in Welding Building: "Panel fed from Main Building Generator"**

3.13 RECEPTACLE CIRCUIT IDENTIFICATION

- A. At each receptacle, identify panelboard and circuit number from which receptacle is served. Use machine printed, pressure sensitive, abrasion resistant label tape on backs of the wall plate and durable wire markers or tags within outlet boxes.

3.14 ADDITIONAL EQUIPMENT LABELS

- A. Refer to individual Division 27 and 28 sections for labeling requirements of low voltage systems.

END OF SECTION 260553



**SECTION 260810 – ELECTRICAL SYSTEMS COMMISSIONING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements for commissioning of electrical systems including lighting systems, time-switch controls and daylight responsive controls. Time-switch controls shall include time-clocks, relay panels, lighting system programs, and other time-based lighting controls.
- B. The contractor, and manufacturer of the applicable systems must work with the commissioning agent to perform all required tests of the system.

**1.2 PROJECTION CONDITIONS**

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during the Commissioning process to minimize conflicts with Owner's operations.
- B. Project Phasing: Refer to the non-technical specifications which indicate the various phases of construction. Provide Commissioning services so that all mechanical systems located within or serving a particular area of the building are complete when the respective area is scheduled for occupancy.

**1.3 SUBMITTALS**

- A. Qualification data for the full-time staff member overseeing the testing, including professional engineering license in the state of the project, or authorization of the local authority having jurisdiction.
- B. Construction Checklists for the systems being commissioned.
- C. At the completion of the tests, turn over all documentation to the local authority having jurisdiction and the owner. All test forms must be dated. All documentation must be turned over to the owner no later than 90 days from the date of the receipt of the certificate of occupancy.

**1.4 QUALITY ASSURANCE**

- A. The commissioning company shall be independent from the installing contractor, vendor and manufacturer.
- B. The commissioning company shall have provided commissioning services for a minimum continuous duration of five (5) years.
- C. The full-time staff member overseeing the testing shall have a valid professional engineering license in the state of the project.
- D. All testing and documentation must conform with the locally adopted version of the International Energy Conservation Code (IECC) 2015. At the completion of the tests, turn over all documentation to the local authority having jurisdiction and the owner.

- E. Wherever any test fails, that particular devices, system, program, etc. shall be rectified and retested. Both the failed and passing report must be turned over to the owner at completion.

## PART 2 - PRODUCTS

Not Applicable.

## PART 3 - INSTALLATION

### 3.1 GENERAL TESTING REQUIREMENTS

- A. All testing must be performed prior to final inspection. All documentation must be signed off by the full-time staff member, and their engineering license information provided on the paperwork affirming that all information in the document is accurate.
- B. All tests shall be performed, as required, to ensure that control hardware and software are correctly calibrated, adjusted, programmed and in proper working condition, in accordance with the construction documents and manufacturer's recommendations.
- C. All tests shall be performed in conjunction with, and in addition to start-up and commissioning requirements as identified in the individual product specifications, outlined on the drawings and required by the manufacturers of the tested systems.
- D. All tests shall be performed to ensure compliance with the currently locally adopted version of the International Energy Conservation Code (IECC), section C405 and C408.

### 3.2 OCCUPANT SENSOR CONTROLS

- A. Tests shall be performed and documented to meet the following requirements:
  - 1. Certify that occupancy sensors have been located and aimed in accordance with manufacturer recommendations to cover the space.
  - 2. If there are greater than seven (7) occupancy sensors, the following tests shall be performed where there is a unique combination of sensor type and space geometry, not less than 10%, but in no case less than one (1) of each unique combination of sensor type and space geometry, unless required by the code official. Where 30% or more of the tested devices fail, all occupancy sensors must be tested to verify compliance. Where there are seven (7) or fewer occupancy sensors, all sensors must be tested.
    - a. Where there are status indicators, verify correct operation.
    - b. Verify controlled lights turn off or reduce to the programmed minimum level within the required time.
    - c. For auto-on sensors, verify the lights turn on to the programmed level.
    - d. For vacancy (manual-on) sensors, verify the lights only turn on when manually activated.
    - e. Verify lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

**3.3 TIME-SWITCH CONTROLS**

- A. Tests shall be performed and documented to meet the following requirements:
1. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules. Document and verify schedules with the owner.
    - a. Provide a final document of the schedules to the owner, including set-up instructions and preference program settings.
  2. Verify the correct time and date in the time switch.
  3. Verify that any battery back-up is installed and functioning.
  4. Verify that override limits are set as identified in the construction documents, or if not listed, that no override time limit is set beyond two (2) hours.
  5. Simulate occupied condition. Verify and document the following:
    - a. All lights can be turned on and off by their respective area control station.
    - b. The station only operates lighting in the enclosed space in which the switch is located.
  6. Simulate unoccupied condition. Verify and document the following:
    - a. All nonexempt lighting, as identified in the locally adopted version of the International Energy Conservation Code (IECC), turns off.
    - b. Manual override controls allow only the lights in the enclosed space where the override station is located to turn on or remain on until the next scheduled shutoff occurs.

**3.4 DAYLIGHT RESPONSIVE CONTROLS**

- A. Tests shall be performed to meet the following requirements:
1. Control devices have been properly located, field calibrated and set for accurate setpoints and threshold light levels.
  2. Daylight controlled lighting loads adjust to light level set points in response to available daylight.
  3. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.

END OF SECTION 260810



**SECTION 260923 – OCCUPANCY SENSORS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.
- B. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.
- C. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including, but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.
- D. Provide factory commissioning as listed in part 3.

**1.2 EQUIPMENT QUALIFICATION**

- A. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- B. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.
- C. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- D. Wall switch and line voltage products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

**1.3 SYSTEM DESCRIPTION**

- A. The objective of this section is to ensure the proper installation of the occupancy sensor-based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
- B. The occupancy sensor-based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

**1.4 SUBMITTALS**

- A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.



- B. Submit typical room plans clearly marked by manufacturer showing proper product, location and orientation of each sensor. Beam patters shall be marked on plans.
  - 1. Location of doors, windows and typical types of room furniture shall be accounted for in the layouts of the sensors. Provide additional sensors as required on the plans.
- C. Submit any interconnection diagrams per major subsystem showing proper wiring.
- D. Submit standard catalog literature which includes performance specifications indicating compliance to the specification.
- E. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

#### 1.5 SYSTEM OPERATION

- A. Factory Startup: It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. This service shall be provided at no additional cost.
- B. Adjustments must include setting the proper sensitivity and time delay in the sensors. Simply changing sensitivity to maximum, unless space requires, shall not be acceptable. The sensitivity shall be set appropriately for the space, to detect half step into room, and detecting people working at a desk at the four (4) corners of the room.
  - 1. Automatic sensitivity or time delay settings shall NOT be used. All sensitivity and time delay settings shall be actively set.
- C. Provide the appropriate sensor for each room. Simply selecting dual technology sensors for every space shall not be acceptable.
  - 1. Where dual technology sensors are used, initial occupancy shall require both technologies (PIR and ultrasonic), while either technology will maintain and re-trigger occupancy.
- D. Sensors shall be set as vacancy (lights turn on by button, maintain by sensing individuals, and turn off when an individual is no longer sensed). Lights shall not operate automatically, unless noted otherwise.
  - 1. Provide compatible low voltage dimmers and wire with sensor. Digitally addressable sensors, dimmers and room controller may be used, provided sensor meets requirements of this specification. When a digitally addressable lighting control system is installed, manufacturer of the sensors and associated devices shall match the system.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identification with labels describing contents.
  - 1. Five (5) low voltage ceiling mounted dual technology occupancy sensors.
  - 2. Three (3) dual voltage wall switch sensors.
  - 3. Five (5) dual voltage power packs.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Watt Stopper.
- B. Sensor Switch.
- C. Hubbell Building Automation.
- D. Greengate.
- E. Lutron.
- F. Leviton.
- G. All occupancy sensors on project shall be from one (1) manufacturer.
- H. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors which meet or exceed the specifications included herein.

2.2 OCCUPANCY SENSORS

- A. Listed products by application shall be Watt Stopper product numbers. Should the contractor choose to use an alternate listed manufacturer, they shall provide the sensor that meets the requirements of the specified sensors. Should an alternate manufacturer require additional sensors due to coverage patterns, they shall be provided at no additional cost to the owner.
  - 1. Instructional and lecture Spaces: Provide, low (24) voltage ceiling mounted dual technology occupancy sensor DT-300 series with isolated relay.
  - 2. Open Offices, Restrooms, Storage Rooms and Corridors: Provide, low (24) voltage ceiling mounted ultrasonic occupancy sensor UT-300 series with isolated relay. Provide coverage pattern to accommodate entire room.
    - a. If sensor is not available with isolated relay, Dual tech sensors may be used in Open Offices to achieve isolated relay functionality; however, the sensor shall be programed as ultrasonic only. Remaining sensors must be ultrasonic type.
  - 3. Private Offices, and Conference Rooms: Provide, low (24) voltage ceiling mounted passive infrared occupancy sensor CI-300 series with isolated relay. Provide coverage pattern to accommodate entire room.
    - a. If sensor is not available with isolated relay, Dual tech sensors may be used in private Offices, cafeteria and conference rooms to achieve isolated relay functionality; however, the sensor shall be programed as PIR only.
  - 4. High Ceiling/Structure Spaces (Welding Shop, 3D Manufacturing, etc.): Provide, low (24) voltage high ceiling mounted passive infrared occupancy sensor HB300B series. provide coverage pattern to accommodate entire space.
  - 5. Wet/damp, Refrigerated, Exterior and Unconditioned Spaces: Provide, low (24) voltage low temperature / wet listed passive infrared occupancy sensor CB-100 series with isolated relay. Provide coverage patter to accommodate entire area.

6. Provide, where indicated, dual (120/277) voltage passive infrared wall switch occupancy sensor PW-300. Set as vacancy so that manual operation is required to turn lights on.
  7. Provide, where indicated, dual (120/277) voltage passive infrared 0-10V dimming wall switch occupancy sensor PW-311. Set as vacancy so that manual operation is required to turn lights on.
  8. Provide a dual (120/277) voltage power packs/lighting controllers (programmed for manual on when connected with low voltage station) and relay packs compatible with sensors as required.
  9. Provide low voltage controls (switches and dimmers), where indicated, compatible with the sensor power pack/lighting controller, from the same manufacturer as the occupancy sensor.
  10. Refer to Division 26 "Lighting Sequence of Operations," for time delay settings. Where no time delay setting is indicated, provide 10-minute time delay.
  11. Manufacturer shall be responsible to provide a shop drawing which indicates correct sensor type and location of sensor within each space.
- B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
  - C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
  - D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
  - E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
  - F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
  - G. Vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
  - H. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
  - I. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
  - J. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
  - K. Dual technology sensors shall be either corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
  - L. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
  - M. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

- N. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within  $\pm 0.005\%$  tolerance, 32 kHz within  $\pm 0.002\%$  tolerance, or 40 kHz  $\pm 0.002\%$  tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- O. All sensors shall be capable of operating normally with LED lighting, electronic ballasts, PL lamp systems and rated motor loads.
- P. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- Q. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- R. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- S. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- T. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- U. All sensors shall have UL rated, 94V-0 plastic enclosures.

### 2.3 CIRCUIT CONTROL HARDWARE – CU

- A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.
- B. Relay Contacts shall have minimum ratings of:
  - 1. 20A – 120 VAC Incandescent
  - 2. 20A – 120 VAC Ballast
  - 3. 20A – 277 VAC Ballast
- C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #12 AWG.
- E. Input voltage shall be dual (120/277) rated.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. All controls shall be set as vacancy (manual operation required to turn lights on), unless noted otherwise.
- B. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- C. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
- D. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the occupancy sensing devices and systems.
- E. Occupancy Sensors shall be provided with minimum 10' additional wiring to allow repositioning of the sensor after the fact for poorly positioned sensors. Extra wire shall be coiled and supported adjacent to the power pack.
- F. Provide label on ceiling grid for location of occupancy sensor power pack above ceiling.
- G. Care shall be used in placing occupancy sensors to ensure proper activation of sensors. Consideration shall be given to HVAC equipment and diffusers, as well as windows and doors. Refer to sensor instruction manual for appropriate placement, in addition to manufacturer submittals.

**3.2 FACTORY COMMISSIONING**

- A. Before wiring between occupancy sensors and lighting control system is started, a pre-installation meeting, lasting a minimum of four (4) hours, shall be scheduled to ensure proper installation and functionality. This meeting shall be performed at the project site between the Distributed Lighting Control Manufacturer, Occupancy Sensor Manufacturer and installing Contractor. During this meeting, wiring connections and placement of devices shall be discussed and fully coordinated to ease the installation process for the contractor. Meeting minutes shall be composed by the contractor indicating time, personal present and discussion topics.

- B. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system. The factory authorized technician shall enter every space containing an occupancy sensor to verify the locations, sensitivity and delay. Any issues that have been noted previous to this visit shall also be addressed. This meeting shall include, at a minimum, the installing contractor, lighting control manufacturer (when installed) and occupancy manufacturer.
- C. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors. This training shall be during an additional visit around substantial completion and last a minimum four (4) hours.
- D. Approximately four (4) weeks after substantial completion, a follow-up meeting lasting a minimum four (4) hours shall be scheduled with the Distributed Lighting Controls Manufacturer, Contractor, and Owner to provide any additional technical assistance required and fine tune all occupancy sensors on the project.
- E. All commissioning visits shall be scheduled a minimum two (2) weeks in advance, and the Architect, Engineer, Owner and Construction Manager/Clerk of the Work shall be informed of all meetings in addition to parties that are to be present. A factory authorized technician shall be present at all required commissioning meetings. Any additional meetings required for a fully functioning system shall be included at no additional cost to the owner.

END OF SECTION 260923



**SECTION 260943 – DISTRIBUTED LIGHTING CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Scope: The following specifications detail the minimum performance and related criteria for the Distributed Lighting Control System. Provide, connect, and furnish all necessary equipment for proper installation and service of the system as indicated on the drawings and specified herein.
- B. Light fixtures shall be supplied with 0-10V dimming drivers, and the lighting control system shall integrate with these drivers.

**1.2 SYSTEM DESCRIPTION & OPERATION**

- A. The Distributed Lighting Control System, as defined under this section, shall include remote power supply cabinets with programming software for programming, dimming and switching interface modules, occupant sensors, daylight sensors, wall controls, and related accessories. The system shall also be capable of direct connection into digital ballasts/drivers and daylight sensors. All ballasts/drivers or modules of the system shall be connected by a communication bus configured of Class 1 or Class 2 wiring.
- B. While not required for functionality, the lighting system shall include a front-end file server/computer and software to allow for program changes and over-ride functions. The software shall include map of the building.
  - 1. Local programming shall be handled with the use of a Wi-Fi enabled hand-held device utilizing the owner's Wi-Fi network.
- C. The lighting system shall be a fully distributed system, with no front-end file server/computer. Programming shall be handled with the use of a Wi-Fi enabled hand-held device utilizing the owner's Wi-Fi network.
  - 1. While the system is to be a fully distributed system with no front-end file server/computer, the system shall be capable of being upgraded to accept a front-end file server/computer added in the future to provide enhanced programming and override commands. The addition of the file server/computer shall be capable of being added by simply connecting to the building network to interface with the lighting control remote lighting hubs.
- D. All programming of the system shall be handled via the owner's network. Under no circumstances shall the system require removal of devices or the ceiling to "plug-in" a device.
- E. The project shall include all connections into the owner's network. Coordinate all requirements with the owner's IT department.
- F. Exterior lighting shall be controlled via lighting contactors.
- G. UL 924 listed devices shall be provided to allow control of life safety lighting.
- H. Provide a written line-by-line review of the specification.



- I. Submit the following according to the Conditions of the Contract, Division 1 and Division 26 Specification Sections.
- J. Product data for each of the products specified. Include data on features, components, ratings, and performance. Include dimensioned drawings with isometric projections of components and enclosures and details of the Ballasts and Modules.
- K. Sample of the equipment, devices, and device plates for color selection and evaluation of technical features, as required by Architect/Engineer.
- L. Wiring diagrams detailing internal and interconnecting wiring for power signal, and control that distinguish between field installed and factory installed wiring.
- M. Coordination Drawings, Equipment Riser Diagram.
- N. Operation and maintenance data for materials and products specified in this Section.
- O. When preparing submittals and any required final programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers. Panel directors shall also reflect the final number schedule.

### 1.3 APPROVALS

- A. Prior approval is required for alternate proposals.
- B. Complete Catalog data, specifications, and technical information on alternate equipment must be furnished to the Architect and Owner at least ten (10) calendar days in advance of the bid date.

### 1.4 QUALITY ASSURANCE

- A. Manufacturer of LMS shall have a minimum of 5 years of continuous experience in manufacturing lighting control products.
- B. Manufacturer of LMS shall have record/history of 5 years of successful lighting control installations.
- C. Manufacturer shall be capable of providing on-site service support within 24 hours in the United States.
- D. Comply with NFPA 70, "National Electrical Code".
- E. LMS, digital ballasts, ballast modules, power supplies, and related accessories shall be UL or CSA marked as appropriate.
- F. Manufacturer shall maintain ISO9001 certification and shall provide copy of certificate upon Engineer's request.

- G. The contractor/manufacturer shall supply to the owner, a written certification of compatibility, to ensure that all components of the LMS are fully compatible with each other for proper system functionality.

1.5 WARRANTY

- A. The manufacturer shall provide a full three-year warranty on all equipment supplied inclusive of system commissioning by a factory employed engineer.
- B. Warranty coverage shall begin on the date that the equipment is energized.

1.6 COMMISSIONING

- A. Before wiring between occupancy sensors and lighting control system is started, a pre-installation meeting, lasting a minimum of four (4) hours, shall be scheduled to ensure proper installation and functionality. This meeting shall be performed at the project site between the network lighting control manufacturer, occupancy sensor manufacturer and electrical contractor. During this meeting, wiring connections and placement of devices shall be discussed and fully coordinated to ease the installation process for the contractor. Meeting minutes shall be composed by the contractor indicating time, personal present and discussion topics.
- B. Upon completion of the installation, the system shall be completely commissioned by factory trained and authorized service personnel. The commissioning will be performed after the electrical contractor ensures the system installation is complete and that all loads have been tested live for continuity and freedom from defects. The system shall be capable of being programmed through the use of a PC with lighting management software. The site visits shall include:
  - 1. Visit site to inspect pre-wiring.
  - 2. Schedule a meeting with the Owner, Engineer, Contractor, and Factory-Employed Engineer to review the lighting control schedule, including but not limited to time limits of each mode, rooms in each group, and control functions per group, as programmed after the initial lighting control meeting.
  - 3. Determine what ballasts are addressed.
  - 4. Determine which sensors, daylight and occupancy, are connected and functioning with the ballasts.
  - 5. Setting lighting zones and device responses to sensor or control input.
  - 6. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. Commissioning tasks shall include entering each room or space and verifying proper operation of the system as it relates to the lighting control schedule. Issues with the lighting control occupancy sensor placement and sensitivity shall be noted so that they can be addressed by the occupancy sensor manufacturer.
  - 7. A factory-employed engineer shall demonstrate and educate the owner's representative(s) on the system capabilities, operation and maintenance.

- C. Upon completion of the system check-out, in a separate site visit, the installer/programmer shall demonstrate the operation of the system to the appropriate owner's representatives during a four (4) hour visit. This demonstration shall present the owner with all of the capabilities of the system, including software features. The visit shall also consist of a walkthrough the building to describe the different functions and user controls.
- D. At least 4 weeks after substantial completion, schedule a follow-up minimum four (4) hour meeting with Owner, Occupancy Sensor Manufacturer and Engineer to make adjustments and address any issues regarding the lighting control schedule, and use of the system's abilities.
- E. Project shall include an additional two (2), four (4) hour site visits and changes to the programming after the owner occupies the building within the first year of operation.
- F. All commissioning visits shall be scheduled a minimum two (2) weeks in advance, and the Architect, Engineer, Owner and Construction Manager/Clerk of the Work shall be informed of all meetings in addition to parties that are to be present. A factory authorized technician shall be present at all required commissioning meetings. Any additional meetings required for a fully functioning system shall be included at no additional cost to the owner.

#### 1.7 MAINTENANCE

- A. The manufacturer shall make available to the end user a method of ordering new equipment for expansions, replacement, or parts to be used as spares twenty-four hours a day, seven days a week. The manufacturer must make available new or remanufactured parts for a minimum period of ten years from the final date of commissioning.
- B. The manufacturer shall supply factory service, new or remanufactured replacement parts, and a service contract that extends the factory-limited warranty from three to five years. In addition, this shall allow end user to purchase this coverage on an annual basis for a minimum period of ten years from the date of final commissioning.

#### 1.8 SPARE STOCK

- A. Provide a minimum of one (1) remote lighting hub, complete with four (4) bus power supplies and all other components.
- B. Provide a minimum of five (5) all other control and interface modules.
- C. Provide a minimum of five (5) low voltage control stations used in educational spaces and two (2) low voltage control stations used in the corridors.
- D. Provide a minimum of two (2) wireless programmers at the completion of the project. The wireless programmers shall come with the necessary software preloaded. Turn over the programmers during the training and retain a receipt and include in the O&M's

PART 2 - EQUIPMENT

2.1 ACCEPTABLE MANUFACTURERS

- A. Lutron Electronics Co., Inc.
- B. N-Light
- C. Watt Stopper
- D. Hubbell
- E. Unless otherwise noted, all basic components (ballast/driver modules (and/or digital ballasts/drivers), wall controls, bus power supplies, relays (line and low voltage), related accessories and programmers) shall be provided by one manufacturer. The occupancy sensors shall be provided as per the Occupancy Sensor specification section.

2.2 REMOTE LIGHTING HUB

- A. Lighting Hubs: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0° C (32°F) to 40° C (104°F) and 90 percent non-condensing relative humidity.
- B. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
- C. Design and test to withstand line-side surges without impairment to performance.
  - 1. Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41B.
- D. Provide lighting hub in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- E. Enables Light Management software to control and monitor digital dimming ballast/driver and interface modules.
  - 1. Remote Lighting Hub shall be capable of communicating with a central lighting file server, should one be installed in the future, utilizing Ethernet connectivity. However, the remote lighting hub shall also be capable of full operation without a central lighting file server.
  - 2. Remote Lighting Hubs shall be supplied with a programming tool, so that a hand-held programmer can program the remote lighting hubs utilizing Wi-Fi connectivity to the building Ethernet.
  - 3. Remote Lighting Hub - Bus Supply
    - a. Connect without interface to:
      - 1) digital ballasts/drivers and/or ballast/driver modules
      - 2) Occupancy sensors.
    - b. Integral fault protection to prevent bus supply failure in the event of a mis-wire.

- c. LED status indicators:
  - 1) Bus supply is powered.
  - 2) Bus supply operating properly.
  - 3) Bus communication.
  - 4) Emergency condition active / non-active.
- d. Configuration switches:
  - 1) Override bus to full light output.
  - 2) Override bus to low end.
  - 3) Override bus to off.
  - 4) Closure inputs normally open/closed.
- e. Each remote Lighting Hub shall be connected to a maximum 4 digital loops of 64 ballasts/drivers or modules.
  - 1) Each loop shall comprise of a maximum four (4) educational spaces.
  - 2) Each remote lighting hub shall only provide loops for the floor for which it is installed, with exception to the corridor/stairwells, which shall have one (1) remote lighting hub to control all corridors and stairwells.
  - 3) Remote lighting hubs shall be installed in panelboard closets, dedicated electric rooms or data closets.

### 2.3 LIGHTING MANAGEMENT SYSTEM COMPUTER

- A. Required for system setup, monitoring, control, graphics, timeclock operation and data logging.
- B. Provided by the control system manufacturer.
- C. Shall have lighting control software preinstalled and tested prior to shipping.
- D. File Server/Computer shall be rack mountable with required components to allow a remote computer to access the software and perform all functions of the lighting control system. The required client software/web address shall be loaded on the same computer as the mechanical BMS terminal computer. Coordinate with the mechanical contractor to install any required programs to interface with the rack mounted computer with their software.

### 2.4 LIGHTING MANAGEMENT SYSTEM SOFTWARE

- A. Provide system software and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. Software Overview:
  - 1. Software includes 5 Client Access Licenses (CALs).
    - a. Each CAL allows the Software to be installed on one PC, and accessed by one or more users using that PC.
    - b. Additional CALs may be purchased in packages of 5.
    - c. Up to two concurrent users

2. Software shall provide the following capabilities
  - a. Setup and Configuration
    - 1) Automatic discovery of all lighting control system equipment including: Remote Lighting Hubs, bus supplies, digital ballasts, ballast modules, sensors and wall controls.
    - 2) Assign names to controllers including bus supplies.
    - 3) Assign names to devices including: Remote Lighting hubs, digital ballasts, ballast modules, sensors and wall controls.
    - 4) Create and modify grouping of devices
    - 5) Create and modify presets
      - a) Presets are set per ballast, module, or per group.
      - b) Set single fade time for each ballast or module.
    - 6) Define spaces and assign devices to the space
    - 7) Graphical Creation Tool for Floorplan Control
      - a) Import floorplan background file types: .bmp, .emf, .exif, .gif, .icon, .jpeg, .png, .tif, .wmf.
      - b) Add icons and associate to devices.
      - c) Associate users with a defaulted floorplan.
  - b. Monitor and Control
    - 1) System summary
    - 2) Individual device status
    - 3) Set light levels or shade positions of groups or individual devices
    - 4) Select presets on groups or individual devices
    - 5) Average light level and calculated power consumption
    - 6) Peak power demand control adjusts light levels to reduce peak power demand.
  - c. Graphical Monitor and Control
    - 1) Floorplan based
      - a) Navigation between multiple floorplans.
      - b) Monitor individual device status
      - c) Set light levels of groups or individual devices
      - d) Select presets on groups or individual devices
  - d. Timeclock
    - 1) Create and modify timeclock events
    - 2) Time-of-day and astronomic events
    - 3) Enable or disable individual timeclock events
    - 4) Set light levels of groups or individual devices.
    - 5) Select presets on groups or individual devices
    - 6) Enable or disable sensors per lighting bus.

- e. Alarms
  - 1) Create and modify alarms
  - 2) Alarm conditions include:
    - a) Failure of lamps associated with a digital ballast.
    - b) Ballast failure or ballast module failure
    - c) Lamp maintenance schedule
    - d) Power threshold by space
    - e) Activate an alarm based on occupancy time periods.
    - f) Execute commands to turn lights on, turn lights off, dim the lights, enable sensors per lighting bus or, disable sensors per lighting bus.
- f. Reports/Logs
  - 1) Calculated power consumption
  - 2) Average light level
  - 3) Log of user activity in LMS software
  - 4) Timeclock events
  - 5) Alarms generated and acknowledgment
- g. User Management
  - 1) Create users and assign access rights.
  - 2) Up to two concurrent users.
- h. Diagnostics
  - 1) Test and verify device operation
- i. Automatic Reconnect
  - 1) If Ethernet connectivity is lost, the lighting hub will reconnect to the server automatically when connectivity is restored.

## 2.5 REMOTE SYSTEM GENERAL PERFORMANCE

- A. The remote system shall be capable of the following performance, regardless of whether a particular feature is installed initially (i.e. daylight sensors are not part of the project, but can be added in the future).
- B. Based on integrated control requirements, system will control lighting with the following hierarchy:
  - 1. Emergency (Highest priority): Ignores all other inputs.
  - 2. Programming: During system programming, sensor inputs are ignored.
  - 3. Occupant sensor: Allows lights to be on/off.
  - 4. Daylight sensor: Imposes a high end limit for light output.
  - 5. Personal control: Fine tune light levels up to the daylight sensor limit.
- C. Response to a single sensor can be unique on fixture by fixture or control module by control module basis.

- D. Power failure recovery - All devices return to their previous light level prior to power loss.
- E. All programmable devices have integral power failure memory to maintain settings for a minimum of 10 years during power loss.
- F. Wall station and sensor replacement is accomplished without programming.

## 2.6 BUS SUPPLY

### A. General

- 1. Connect without interface to:
  - a. Occupancy sensors.
  - b. Building management / integration contact closure outputs.
  - c. Fire alarm or security system contact closures.
  - d. Emergency lighting interface listed to UL 924.
- 2. Integral fault protection to prevent bus supply failure in the event of a mis-wire.
- 3. LED status indicators:
  - a. Bus supply is powered.
  - b. Bus supply operating properly.
  - c. Bus communication.
  - d. Emergency condition active / non-active.
- 4. Configuration switches:
  - a. Override bus to full light output.
  - b. Override bus to low end.
  - c. Override bus to off.
  - d. Closure inputs normally open/closed.

### B. Field Mounted Bus Supply

- 1. Integral clip for mounting on DIN rail.

### C. Wall Mounted Bus Supply

- 1. Provide digital bus power supply in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

## 2.7 BALLAST/DRIVER MODULE

### A. General

- 1. Required to provide continuous 3-Wire signal dimming to 3-Wire electronic dimming ballast/driver. Or, provide 4-Wire signal dimming to a 4-Wire electronic dimming ballast/driver.
- 2. Generate digital communication commands to distribute ballast/driver and sensor data on the digital bus.



3. If power is interrupted and subsequently returned, lights automatically return to the setting prior to power interruption.
4. Each ballast/driver responds independently:
  - a. Up to 64 occupant sensors.
  - b. Up to 64 personal control inputs.
  - c. 2 daylight sensors.
5. Unique internal reference number visibly displayed on module cover.
6. Averages 2 independent daylight harvesting inputs internally.
7. Electrical: Dimmer to meet limited short circuit test as defined in UL 20.
8. Provide integral fault protection to prevent ballast/driver module failure in the event of a mis-wire.

**B. 2 Amp 3-Wire Ballast Module**

1. Ballast module to integrate up to 2 amps of Lutron 3-wire electronic dimming ballast into a digital control system as a single zone.

**C. 16 Amp 3-Wire Ballast Module**

1. Ballast module to integrate up to 16 amps of Lutron 3-wire electronic dimming ballast into a digital control system as a single zone.

**D. 16 Amp Switching Module**

1. Switching module to provide a 16 amp switch relay into a digital control system as a single zone.

**2.8 DIGITAL BALLAST/DRIVER / I/O MODULE**

**A. General**

1. I/O Module shall be the common interface to a ballast/driver or sensor.
2. Addressing: I/O Module shall be individually addressable via Energy Control Software.

**B. Electrical Specifications**

1. Ratings: Shall be low voltage input.
2. Voltage Compatibility: Universal voltage control capability to 347 VAC maximum.
3. Primary Relay Rating: 347V, 0.8A/277V, 1A/240V, 1.2A/120V, 2.5A
4. Ballast/driver Compatibility: Suitable for use with electronic dimming ballasts/driver using a 0 to 10 VDC dimming signal, such as Advance Mark VII 0-10V.
5. Power: Shall supply 12 VDC @ 25 mA power to attached sensor.
6. Control Signal: Shall supply 0 to 10 VDC dimming signal to attached ballast/driver or receive control signals from attached sensor.
7. Memory: Retains all system settings in non-volatile memory.

**C. Mechanical Specifications**

1. Wiring: I/O Module shall not require wiring connections to the System apart from prefabricated, quick connecting low voltage wiring.

- D. Environmental Specifications
  - 1. Operating Temperature Range: 0°C to +40°C
  - 2. Relative Humidity: 20% to 90% non-condensing

## 2.9 LIGHTING CONTROL MODULE/PANEL

- A. Provide lighting control modules as required to control the loads indicated.
- B. General Requirements:
  - 1. Listed to UL 508 as industrial control equipment.
  - 2. Delivered and installed as a listed factory-assembled panel.
  - 3. Passively cooled via free-convection, unaided by fans or other means.
  - 4. Mounting: Surface.
  - 5. Connection without interface to wired:
    - a. Occupancy sensors.
    - b. Daylight sensors.
    - c. IR receivers for personal control.
  - 6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
  - 7. Contact Closure Input:
    - a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
      - 1) Activate scenes.
        - a) Scene activation from momentary or maintained closure.
      - 2) Enable or disable after hours.
        - a) Automatic sweep to user-specified level after user-specified time has elapsed.
        - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
        - c) Occupant can reset timeout by interacting with the lighting system.
      - 3) Activate or deactivate demand response (load shed).
        - a) Load shed event will reduce lighting load by user-specified amount.
  - 8. Emergency Contact Closure Input:
    - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
    - b. Allow configurable zone response during emergency state.
    - c. Disable control operation until emergency signal is cleared.

9. Supplies power for control link for keypads and control interfaces.
  10. Distributes sensor data among multiple lighting control modules.
  11. Capable of being controlled via wireless sensors and controls.
- C. Switching Lighting Control Modules/Panels:
1. Switching:
    - a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
    - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
    - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
    - d. Module to integrate up to four individually controlled zones.
    - e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
  2. Provide switching lighting control modules to control exterior and other relay loads indicated.
- D. 0-10V Lighting Control Modules:
1. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
  2. Single low voltage dimming module; capable of controlling following light sources:
    - a. 0-10 V analog voltage signal.
      - 1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
      - 2) Sink current per IEC 60929.
  3. Switching:
    - a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
    - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
    - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
    - d. Module to integrate up to four individually controlled zones.
    - e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
  4. Provide 0-10V lighting control modules to control 0-10V dimming loads. Refer to lighting fixture schedule for fixtures with 0-10V drivers.
- E. Digital Fixture Lighting Control Modules:
1. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
  2. Provide testing capability using manual override buttons.
  3. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

2.10 LOW-VOLTAGE WALL STATIONS

- A. Product: Provide low-voltage wall station controls as defined on projects drawings and schedules
- B. General:
  - 1. Class 2 (low voltage).
  - 2. Integral IR receiver for programming where required for system programming.
  - 3. Immediate local LED response upon button activation to indicate that a system command has been requested.
  - 4. Wall stations can be replaced without reprogramming.
  - 5. Provide finish as selected by architect from manufacturer's full list of standard finishes (not metal finish).
  - 6. Wall stations shall be wired to the bus power supply, ballast/driver, ballast/driver module or ballast/driver digital loop. If the bus power supply is disconnected from the lighting system for any reason, this shall not restrict the use of the wall stations.
  - 7. **Wall stations shall be provided with inset style, fitting a Decora style wall plate. Wall plates shall match those as specified in Division 26 "Wiring Devices".**
- C. Standard room stations shall be provided as follows, unless noted otherwise:
  - 1. Offices and educational spaces (including cafeteria, gymnasium, etc.) shall be provided with three (3) button + raise lower station to provide the following functions: 'on', 'off', 'AV mode', 'raise' and 'lower'.
  - 2. Corridors shall be provided with single key type stations to provide simple on/off control.
  - 3. Where possible, provide analog type controls, however digital controls shall be provided where required to achieve desired control.
- D. One Button Control
  - 1. Toggle on/off and master raise/lower control for group of fixtures.
  - 2. "Press and Hold" button programming for creating and modifying groups.
- E. Four Button Control
  - 1. Recall 4 Scenes plus all on or all off for one group of fixtures.
  - 2. Master raise/lower control entire group of fixtures.
  - 3. "Press and Hold" button programming supports:
    - a. Create and modify groups.
    - b. Modify scene levels.

2.11 SENSORS

- A. General:
  - 1. Use Class 2 wiring for low voltage communication.
  - 2. Can be replaced without reprogramming.

B. Interior Daylight Sensors

1. Open-loop basis for daylight sensor control scheme.
2. Stable output over temperature from 0° to 40° C.
3. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
4. Provide linear response from 0 to 500 foot-candles.
5. Integral IR receiver for programming.
6. Constructed with plastic meeting UL94 HB.
7. Daylight sensors shall be wired to the bus power supply, ballast, ballast module or ballast digital loop. If the bus power supply is disconnected from the LMS for any reason, this shall not restrict the use of the sensors.

C. Occupancy Sensors

1. Provide occupancy sensors as per Division 26 "Occupancy Sensors".
2. Connect occupancy sensors to the network lighting control system as per manufacturer's recommendations.
3. Low Voltage (24V) occupancy sensors shall be wired to the bus power supply, ballast, ballast module or ballast digital loop. If the bus power supply is disconnected from the LMS for any reason, this shall not restrict the use of the sensors.

2.12 POWER INTERFACES

A. Product: Provide required power interfaces as defined on projects drawings and schedules.

B. Electrical:

1. Phase independent of control input.
2. Dimmer to meet limited short circuit test as defined in UL 20.

C. Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

2.13 ACCESSORIES

A. Tamper Proof Covers:

1. Locking covers for preset control units and wall stations: Reversible to allow lock to be located on either side of control.
2. Compatible with IR controls.

2.14 SOURCE QUALITY CONTROL

A. Perform full-function testing on all completed assemblies at end of line. Statistical sampling is not acceptable.

B. Diagnostics and Service - Tiered control scheme for dealing with component failure that minimizes loss of control for occupant.

1. Bus failure: Lights go to emergency level for safety.
  2. Failure of one sensor type: Ballast/driver still controllable via other sensors.
  3. Ballast/Driver failure: Only impacts one fixture - remainder of system operates as programmed.
- C. Equipment shall be 100% tested for proper operation at three different levels—printed circuit board, end of line, and for two hours at 40°C (104°F) ambient—prior to shipment from the factory. Manufacturers sampling at end-of-line shall not be acceptable.

## 2.15 CONTROL INTERFACES

### A. Contact Closure Interface(s)

1. Control shall provide two way interface between controls and dry contact closure devices such as from Timeclock Inputs, Building Management Systems, Fire Alarm Systems, Security Systems, and Occupancy Sensors. Control shall provide a minimum of five input and five output terminals. Input terminals must be able to accept maintained or momentary inputs with a minimum pulse time of 40msec. Inputs must have an on-state saturation voltage less than 2.0VDC and an off-state leakage current less than 10mA. Outputs must be capable of controlling other manufacturers' equipment. Customer provided output indicators must not exceed 200mA at 30VDC. Following functions shall be available and shall be set up in software: scene selection, panic mode, occupancy response, sequencing, zone and scene lockouts, and partitioning.

### B. BACnet Interface

1. Control shall provide the ability to communicate via BACnet IP communication to the centralized lighting system from a user supplied 10/100BaseT Ethernet network.
2. The control shall provide access to scene selection in defined spaces or setting of Intensity in defined zones.
3. The control shall be capable of interfacing to other equipment (Building Automation System, Security System, Fire Alarm System, Life Safety System, and Card Access System) via the BACnet IP interface. The BACnet IP based interface software shall be the responsibility of secondary system manufacturers (Building Automation System, Security System, Fire Alarm System, Life Safety System, and Card Access System). The Manufacturer shall provide a BACnet IP interface object model specification to secondary equipment manufacturers for their use.
4. Provide points list to HVAC contractor for interface between the systems.

## 2.16 INTERCONNECTIONS TO OTHER SYSTEMS

- A. UL924 listed voltage sensing units shall be provided at each remote lighting hub and be connected to the lighting panel associated with the lighting in the area. Connect to the breaker indicated in the lighting panelboards.
- B. Provide a connection with the mechanical building management system via Bacnet over IP to control the exterior lighting relay panels.
- C. Provide contact closure inputs and outputs from the Integrated Access Control/Security System to perform the following functions:

1. Receive information when the Integrated Access Control/Security System receives a valid card and disarms the system.
  2. Receive information when the Integrated Access Control/Security System is armed.
  3. Receive information from the Integrated Access Control/Security System when the building security system is violated and goes into alarm.
  4. Receive information from the Integrated Access Control/Security System when the building security system has been reset after an alarm.
  5. Provide one (1) alarm outputs to the Integrated Access Control/Security. This output will be to monitor the occupancy sensors. Should the owner choose, these can be used to initiate an alarm condition with the building is armed. (Reprogramming may be performed within the year at the predetermined training visits)
  6. All necessary contact closures shall be furnished as part of the system and be programmed as required.
- D. Provide contact closure inputs from the life safety ATS to determine when the switch transfer to emergency power. All necessary contact closures shall be furnished as part of the system and be programmed as required.
- E. Provide contact closure inputs from the fire alarm system to determine when the fire alarm system is initiated. All necessary contact closures shall be furnished as part of the system and be programmed as required.

#### 2.17 ADDITIONAL EQUIPMENT

- A. **Furnish and install all necessary data wiring and hardware, including, but not limited to, data cable, terminations, data switches, etc. to provide a fully functioning lighting control system.**
- B. Furnish and install all necessary power connections for lighting control power supplies, etc. Power shall be derived from spare 20A/1P breakers in the nearest 120/208V normal power panel. Provide any additional breakers as required.
- C. Locate file server lighting control computer in one of the freestanding data racks and plug into provided power strip.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Communication wiring between ballasts may be either Class 1 or Class 2 wiring as required. If wiring is run separate from power, provide plenum rated Class 2. If run with power, the wiring shall be Class 1 rated.
- B. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the devices as indicated on the drawings and specified herein. System setup shall include defining and setting all control functions, installation of hardware and software, and instructions to the owner or owner representative.
- C. Contractor shall install Lighting Management System Computer in the data rack at the MDF.

- D. Contractor shall install lighting hubs on wall in data closets, electrical closets or as directed on the drawings. Provide cord and plug on lighting hubs and connect to dedicated receptacle located on wall adjacent to remote lighting hubs.
- E. **The project shall include all connections into the owner's network. Coordinate all requirements with the owner's IT department.**

3.2 LABELING

- A. Provide self-adhesive label with software identification on all connected devices.
- B. Provide self-adhesive label with data jack identification on all data network connected devices.
- C. Where devices are located above the ceiling, provide self-adhesive label on ceiling T-bar with device identification and the words "Lighting Control System Device".

3.3 FIELD QUALITY CONTROL

- A. Manufacturer shall be capable of providing on-site service support within 24 hours of a service call in the USA, + within 72 hours anywhere in the world, except where special visas are required.
- B. Manufacturer shall provide toll-free technical support 24 hours per day, 7 days a week.
- C. Manufacturer shall offer upgraded warranty based upon successful field commissioning.
- D. Manufacturer shall offer a renewable service contract on a year to year basis, which will include parts and factory labor as well as annual training visits.
- E. Service Contracts will be available for up to ten years from date of system commissioning.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide services as listed under Commissioning in Part 1 of this section.

END OF SECTION 260943





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**SECTION 260950 – LIGHTING SEQUENCE OF OPERATIONS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control sequences for building lighting systems and equipment. Sequence of operation is hereby defined as the manner and method by which various controls and systems function. Initial requirements for the operation of each type of space are specified in this section and/or on the contract drawings. Provide all necessary materials and labor to supply a complete and fully operational system.
- B. The system shall include a completely distributed control system with **no** required front-end computer. Programming shall be handled via the Wi-Fi network using a hand-held device should a front-end computer be provided or not. Refer to Division 26 “Distributed Lighting Control System” for additional information.
- C. Provide connections to other systems as listed in part 3.**
- D. Light fixtures shall be supplied with 0-10V dimming drivers, and the lighting control system shall integrate with these drivers.

1.2 SHOP DRAWINGS: Submit shop drawings in coordination with the “Distributed Lighting Control System” shop drawings:

- A. Provide a description of how the building will be initially programmed as a whole, including the control of and afforded to any and all interconnecting systems.
- B. Provide a description of how each space will be initially programmed including the hierarchy of control sequences, whether the space is listed within this specification or not.
- C. Provide a full single-line diagram showing all control devices and the connection points. Diagrammatically show the associations of these control devices with the applicable spaces. The single-line shall also show connections to other systems, indicating method and communications protocol.
- D. Provide layout drawings indicating the proper location of daylight sensors.
- E. Coordinate the connection of occupancy sensors with the occupancy sensor supplier. Show these connections in detail.
- F. Coordinate the connection of other lighting control systems and control devices, including, but not limited to remote architectural control systems, remote theatrical control systems and touchscreens. Review drawings and specifications for additional information.
- G. Maintenance Data: Include copy of shop drawings in each maintenance manual; in accordance with requirements of Division 1.
- H. When preparing submittals and programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL LIGHTING CONTROL SEQUENCES

A. Scheduled Control

1. Each remote lighting hub shall be capable of being provided with a predetermined scheduled control via the following methods:
  - a. Scheduled time of day through the use of a timeclock or front-end computer.
  - b. Indication from any connected system (i.e. BMS).
  - c. Indication from a contact closure connected to a system or device (i.e. photoelectric cell).
2. Should a front-end file server/computer be added in the future, scheduled control shall be capable of being set independently for each space and/or relay based on the above control methods.

B. Occupancy Sensors

1. The occupancy sensors in each space shall be programmed to control, at a minimum, the lighting within that space.
2. Occupancy sensors that are connected with the system shall be capable of controlling any lighting fixture and/or relay connected within the system through programming.

C. Occupant Control

1. In addition to the use of occupancy sensors, each indicated space shall have local occupant controls.
2. Unless otherwise stated, local occupant controls shall be used to activate the local lighting, and connected occupancy sensors to maintain lighting, and provide automatic off (i.e., vacancy sensor setting).
3. The local occupant controls shall be capable of turning the local lighting off.
4. The local occupant controls shall be capable of dimming the local lighting.
5. Through programming, the local occupant controls shall be capable of being a local override to the scheduled control. Override shall last a maximum of 2 hours without additional intervention.

D. Daylight Harvesting

1. Each space indicated with a daylight sensor shall be programmed with daylight harvesting.
2. Each row parallel with the window wall shall be set with individual gains according to the amount of daylight that enters the room proportional to each other row.
3. Where an average amount of light is not indicated elsewhere for each space, it shall be assumed that an average of 40 foot-candles for direct lighting and 35 foot-candles for indirect lighting shall be maintained.

4. Lighting shall reach a minimum level of lighting without turning off. Any changes to the lighting shall happen at such a rate that the occupants are not aware of any dimming of the light fixtures.

E. General Order of Operations

1. Each space/relay shall follow the following order of operations, where applicable, unless noted otherwise in the specifications or drawings:
  - a. On-Off Control:
    - 1) Local Occupant Control.
    - 2) Local Occupancy Sensors.
    - 3) Override control of connected systems.
    - 4) Time-of-day schedule.
  - b. In spaces with dimming control, the lowest value shall always take precedence.

F. Normal/Emergency lighting:

1. In spaces where normal/emergency lighting is indicated along with normal lighting that is controlled via the system, the normal/emergency lighting shall function with the normal lighting so that the occupancy has no idea that there are two (2) different lighting circuits in the space.
2. If the building loses power, the control for the lighting shall fail, and the normal/emergency lighting shall operate at 100% light output from the emergency generator.
3. In spaces where normal/emergency lighting is indicated, but the normal lighting is controlled outside of the system (i.e., occupancy sensor with power pack, or just a wall switch), the normal/emergency lighting shall operate at 100% 24 hours per day.

3.2 INITIAL SPACE SPECIFIC CONTROL SEQUENCES

A. Exterior Lighting:

1. All exterior lighting, including, but not limited to, non-security building lighting, area lighting, building sign lighting, etc. shall be controlled with photocell on/photo eye off.

B. Corridor Lighting:

1. Low voltage switches are being provided throughout the building in the corridors. These wall switches shall be used to provide a 2 hour override, to operate the corridor lights at the programmed high level.
2. Occupancy sensors connected to the lighting system shall automatically turn the lights on when a person is detected, to an owner preset high level, for a period of 5 minutes after detecting someone.

C. Interior Spaces (including offices, Theory rooms, etc.), Office and Theory Room Lighting:

1. Occupancy sensors connected with the lighting system shall be set as vacancy sensors, so that to turn the lights on, a person has to manually activate the wall control. When a person uses the local occupant control, the lights shall turn on to the level indicated. As long as the occupancy sensor detects a person, the lights shall remain on. The lights shall turn off when the occupant turns off the lights via the local occupant control. If the occupancy sensor stops detecting a person for 10 minutes, the lights shall turn off.

D. Multi-gang Restroom Lighting:

1. Occupancy sensors connected to the lighting system shall automatically turn the lights on when a person is detected, to an owner preset high level, for a period of 5 minutes after detecting someone.

E. Storage Lighting:

1. When a person is detected by the occupancy sensor, the lights shall turn on, unless the local line voltage switch is in the off position.
2. When the occupancy sensors do not detect a person for a period of 5 minutes, the lights shall turn off.
3. General storage room lighting is not controlled via the distributed digital lighting control system and uses line voltage controls unless noted otherwise.

3.3 CONNECTION TO OTHER SYSTEMS

- A. UL924 listed voltage sensing units shall be provided at each remote power supply and be connected to the lighting panel associated with the lighting in the area. Connect to the breaker indicated in the lighting panelboards.
- B. Provide a connection with the fire alarm system via contact closure. When the fire alarm system goes into alarm, all of the connected lighting shall go to full output. When the fire alarm system is reset, the lights shall go to their preset level. This connection shall be 1-way.
- C. Provide a connection with the security system via contact closure. In addition to previously stated information to be passed, when the security system goes into alarm, all of the connected lighting shall go to full output. The lighting control system shall not reset until an override command is present, either within the LMS or by occupant control device installed for this purpose. This connection shall be 2-way.

END OF SECTION 260950

**SECTION 262213 – LOW-VOLTAGE DRY-TYPE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

**1.2 SUBMITTALS**

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Vibration Isolators: Provide product data on vibration isolators to be provided at each transformer. Refer to Paragraph "Installation," below.

**1.3 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- 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 IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

**1.5 COORDINATION**

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company.
- B. Siemens equivalent.
- C. GE by ABB equivalent.
- D. Eaton (Cutler Hammer) equivalent.
- E. No Other Manufacturers Will Be Considered.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Copper, Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250.
  - 1. Provide NEMA Type 2 for interior applications and NEMA Type 3R for exterior applications unless otherwise noted on the drawings.
  - 2. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- E. Energy Efficiency for Transformers Rated 15 kVA and Larger:
  - 1. Marked as compliant with currently adopted DOE and Energy Code efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - 2. Tested according to NEMA TP 2.
- F. Wall Brackets: Manufacturer's standard brackets.
- G. Low-Sound-Level Requirements: Maximum sound levels shall meet NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions. Provide 4" concrete housekeeping pad under transformer.
- C. Provide vibration isolation pads at transformers providing a minimum static deflection of 0.3 inches similar to Kinetics 2" KIP.
- D. Verify all dimensions in the field.
- E. Adjust transformer secondary voltages to provide the required voltage at the loads.

3.3 IDENTIFICATION

- A. The requirements listed below are in addition to the requirements listed in Division 26 "Electrical Identification."
- B. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws.

3.4 CONNECTIONS

- A. Connect ground equipment.
- B. Connect wiring.



- C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies.
- E. Conduit connections to transformers shall employ sufficient length of flexible conduit to create a U-shaped bend.

**3.5 ADJUSTING**

- A. Record transformer secondary voltage at unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare written report recording output voltages and tap settings.

**3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

**SECTION 262250 – SERVICE ENTRANCE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Arrangement with utility company for permanent electric service. Refer to Division 26 “Basic Electrical Requirements,” and applicable Division 01 sections for payment of charges billed by utility company.
- B. Underground primary and secondary service work.

**1.2 REFERENCES**

- A. ANSI/NFPA 70 - National Electric Code.
- B. System Characteristics: Primary voltage 277/480 volts wye, 3-phase, 4-wire, 60 Hertz.

**1.3 QUALITY ASSURANCE**

- A. Perform work in accordance with utility company written requirements.
- B. Maintain one copy of each document on site.

**1.4 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.

**1.5 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated on utility company drawings.

**PART 2 - PRODUCTS**

NOT APPLICABLE

**PART 3 - EXECUTION**

**3.1 CONTRACTOR COORDINATION**

- A. Electrical Contractor will provide the following:
  - 1. In ground flush with grade boxes.
  - 2. All conduit (underground Sch. 40 PVC, exterior exposed rigid galvanized steel, Interior EMT).
  - 3. Concrete encasement for all underground secondary conduits.
  - 4. All secondary cables (600 volt).
  - 5. All terminations.

6. Circuit breaker for main switchboard.
7. New welding building service panel.

B. Verify that service equipment is ready to be connected and energized.

END OF SECTION 262250

**SECTION 262416 – PANELBOARDS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
  - 1. Lighting and appliance branch circuit panelboards.
  - 2. Distribution panelboards.
  - 3. TVSS Devices.
- B. Provide product demonstration and startup as listed in part 3 for distribution branch feeder metering devices or integrated TVSS devices.

**1.2 DEFINITIONS**

- A. GFCI: Ground fault circuit interrupter.

**1.3 SUBMITTALS**

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and Manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current, and voltage ratings.
    - c. Short circuit current rating of panelboards and overcurrent protective devices.
    - d. UL listing for series rating of installed devices.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between Manufacturer installed and field installed wiring.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- D. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time current curves, including selectable ranges for each type of overcurrent protective device.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Division 01 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for switchboards and all installed components.
    - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

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 NEMA PB 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company.
- B. Siemens.
- C. GE by ABB.
- D. Eaton (Cutler Hammer).
- E. No Other Manufacturers Will Be Considered.

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush and surface mounted cabinets. Refer to panel Schedules on Drawings to determine flush or surface. NEMA PB 1, Type 1 for interior locations and Type 3R for exterior locations, unless noted otherwise in the documents.
- B. Front: See panelboard, Hinged Trim Covers.

- C. Finish: Manufacturer's standard enamel finish over corrosion resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus Material (Main, Neutral & Ground): **Hard drawn copper.**
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch circuit equipment ground conductors; bonded to box.
- H. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches. Provide when indicated on the panel Schedules.
- I. Skirt for Surface Mounted Panelboards: Provide skirts with same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. Skirts shall be provided for all surface mounted panels in all rooms with exception of rooms labeled on plans "Electric or Mechanical."
- J. Feed through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- K. **Provide a HPI Cable connected TVSS Unit when indicated on riser diagram. TVSS shall not be integrated in panelboard, device shall be external to panelboard. Refer to Division 26 "Transient Voltage Surge Suppression" for TVSS information.**

### 2.3 PANELBOARD SHORT CIRCUIT RATING

- A. Panelboards shall be fully rated to interrupt symmetrical short circuit current as indicated on the schedules. All breakers within panelboards shall be fully rated to the panel AIC rating. Series ratings of branch breakers or bus shall not be acceptable.

### 2.4 ARC ENERGY REDUCTION

- A. For any circuit breaker rated for 1200A, or can be adjusted to 1200A or higher, an electronic circuit breaker must be used, and the following shall be provided:
  - 1. Documentation shall be made available, at the switchboard, regarding the Arc Energy Reduction methodology.
  - 2. The applicable breaker shall be provided with an energy-reducing maintenance switch setting with local status indicator.

### 2.5 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: See Panelboard Hinged Trim Covers.

**2.6 DISTRIBUTION PANELBOARDS**

- A. Doors: Front mounted secured with latch and lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker or Main Lugs Only. Refer to panel Schedule.
- C. Branch Overcurrent Protective Devices: Bolt on circuit breakers.

**2.7 OVERCURRENT PROTECTIVE DEVICES**

- A. Lighting and Appliance Branch Circuit Panelboards:
  - 1. Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
    - a. Thermal Magnetic Circuit Breakers: Inverse time current element for low level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.
    - b. GFCI Circuit Breakers: Single pole configurations with 5mA trip sensitivity.
  - 2. Molded Case Circuit Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
    - a. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
    - b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air conditioning, and refrigerating equipment.
    - c. Ground Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time delay settings, push to test feature, and ground fault indicator.
    - d. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
- B. Distribution Panelboards, 600A main lug and larger
  - 1. 100A and larger, provide electronic trip units with LSI (Long time, Short time and Instantaneous) protection, size as specified on the drawings. Interrupting rating shall be available up to 200 kAIR RMS without fuses. Under 100A, provide thermal magnetic trip units, size as specified on the drawings.
    - a. Circuit Breakers
      - 1) Circuit breakers shall have voltage and interrupting ratings that meet the application requirements.
      - 2) Circuit breakers shall be constructed using glass reinforced insulating material.
      - 3) Current carrying components shall be completely isolated from the handle, and the accessory mounting area.
      - 4) Circuit breakers shall have an over center, trip-free, toggle-operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
      - 5) Up to 600 A rating frame, MCCBs breaking unit shall be made with a double rotary contact to limit let-through energy on the installation.

- 6) MCCBs shall be designed to trip the circuit breaker in the event of high-level short-circuit currents. This design shall be independent of the trip unit.
- 7) The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing international I/O markings.
- 8) The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on the face of the circuit breaker.
- 9) Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
- 10) Circuit breakers shall be factory-sealed with a hologram quality mark or a tamper evident label and shall have a date code.
- 11) MCCB's shall be able to receive a device for locking in the isolated position.
- 12) Electronic components shall withstand temperatures up to 221 °F (105 °C).
- 13) Circuit breakers shall be UL-listed to accept field installable/removable mechanical type lugs. Lugs shall be UL-listed to accept solid and/or stranded copper and aluminum conductors. Lugs shall be suitable for 194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC.
- 14) Circuit breakers shall be capable of accepting bus connections.
- 15) For frame ratings, higher than 250 amperes, MCCBs shall be fitted with metallic filters to reduce effects perceptible from the outside during current interruption.
- 16) For a given MCCB rated frame, MCCBs dimensions shall be the same whatever the AIR.
- 17) 1200 amperes frame shall be provided in electrically operated version. The operation shall use stored-energy type only and will be equipped with anti-pumping function.
- 18) Circuit breakers, 600A and larger, shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.

b. Trip Units

- 1) MCCB's, 100A and larger shall be equipped with electronic trip units. MCCB's less than 100A shall be equipped with thermal magnetic trip units.
- 2) Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
- 3) MCCBs with field interchangeable trip units (600A and larger) shall have trip units that are easily interchangeable and easily secured to the MCCB.
- 4) The trip units shall not augment overall circuit breaker volume.
- 5) Thermal Magnetic (less than 100A):
  - a) Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.
  - b) Where indicated on drawings, circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.
- 6) Electronic Trip Circuit Breakers (100A and larger):



- a) Trip unit shall be true RMS sensing.
- b) Air core current transformers shall be used to ensure accurate measurements from low currents up to high currents.
- c) Electronic trip unit shall be fitted with thermal imaging to protect intermittent short circuits or ground-faults.
- d) The following monitoring functions shall be integral parts of electronic trip units:
  - i) A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
  - ii) LED for load indication at 105 percent.
  - iii) LED for load indication at 90 percent of load for applications 600 amperes and smaller.
  - iv) LED for visual verification of protection circuit functionality for applications 600 amperes or smaller.
  - v) LED for trip indication for applications above 600 amperes.
  - vi) Trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
  - vii) Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug ( $I_n$ ), with finer adjustments available for more precise settings to match the application.
  - viii) Adjustable long-time delay shall be in nine bands. At six times  $I_r$ , from 0.5 to 24 seconds above 600 amperes, and 0.5 to 16 seconds for 600 amperes and below.
  - ix) Short-time pickup shall allow for nine settings from 1.5 to 10 times  $I_r$ .
  - x) Short-time delay shall be in nine bands from 0.1-0.4  $I^2t$  ON and 0-0.4  $I^2t$  OFF.
  - xi) Instantaneous settings on the trip units with LSI protection shall be available in nine bands.
    - 1. Above 600 amperes, from 2 to 15 times  $I_n$
    - 2. 600 amperes, from 1.5 to 11 times  $I_n$
    - 3. 400 amperes from 1.5 to 12 times  $I_n$
    - 4. 250 amperes and below, from 1.5 to 15 times  $I_n$
  - xii) Four-pole devices shall be equipped for neutral protection with a three-position setting; neutral not protected, neutral tripping threshold equal to half the phase value, and neutral threshold equal to the phase value.
  - xiii) Ground fault settings for circuit breaker sensor sizes 1200 amperes or below shall be in nine bands from 0.2 to 1.0 times  $I_n$ . The ground fault settings for circuit breakers above 1200 amperes shall be nine bands from 500 to 1200 amperes.
- e) It shall be possible to fit the trip unit with a seal to prevent unauthorized access to the settings in accordance with NEC Section 240-6(b).
- f) Trip unit shall provide local trip indication and capability to locally and remotely indicate reason for trip, i.e., overload, short circuit, or ground fault.
- g) Measurement chain shall be independent from the protection chain.
- h) The measurements shall be displayed on the breaker itself.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.
- C. Provide top and bottom panel skirts for all surface mounted lighting and power panels.

2.9 HINGED TRIM COVERS

- A. Provide Hinged Trim Panelboard covers for lighting and power panelboards. Entire Trim Hinged to one side of the box with a piano type hinge to access panel gutter space. Front door of panel shall be keyed to lock.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Refer to Section 260553 for more information.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub two 1-inch empty conduits below slab not on grade into suspended ceiling cavity.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Provide panel and circuit identification as outlined in Division 26 "Electrical Identification".

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to Manufacturers' published torque tightening values. If Manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

**3.4 FIELD QUALITY CONTROL**

- A. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded case circuit breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load balancing circuit changes outside normal occupancy/working Schedule of the facility and at time directed. Avoid disrupting critical 24 hour services such as on line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 10 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

**3.5 PROTECTIVE SHIELDS**

- A. Provide metal protective shield(s) under all piping located within 3'-0" of the panelboard to deflect a pipe leak away from the electrical equipment. Shield(s) shall be sized as required to cover the required pipe to prevent water from reaching the panelboard.

**3.6 ADJUSTING**

- A. Set field adjustable switches and circuit breaker trip ranges.

**3.7 CLEANING**

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

**3.8 DEMONSTRATION AND START-UP**

- A. Adjust all adjustable settings. When a coordination study is performed, adjust breakers and ground fault circuit interrupters as required per the study.
- B. Engage a factory authorized service representative to train Owner's maintenance personnel to operate, and maintain distribution branch feeder metering devices and TVSS devices.

END OF SECTION 262416

**SECTION 262726 – WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes receptacles, connectors, switches, dimmers, finish plates and cord reels.

**1.2 DEFINITIONS**

- A. GFCI: Ground fault circuit interrupter.

**1.3 SUBMITTALS**

- A. Product Data: For each product specified.
- B. Shop Drawings:
  - 1. Legends for receptacles and switch plates, where indicated on the drawings.
  - 2. Cord Reels.
- C. Samples: For devices and device plates for color selection and evaluation of technical features, when requested by the Architect-Engineer and/or Owner.
- D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

**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.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.
- D. Compliance with Federal Specifications – identified by the federal specifications mark (capital letters 'F' and 'S' each in a wing on either side of the UL Listing mark):
  - 1. Receptacles and GFCI's: Federal Specification number WC596.
  - 2. Switches: Federal Specification number WS896.

**1.5 COORDINATION**

- A. Receptacles for Owner Furnished Equipment, or Equipment furnished by other trades: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
  - 1. Extra Keys: Provide minimum five (5) keys for each type of key.
  - 2. GFCI Receptacles: five (5).

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers
  - 1. Hubbell HBL1221 Series.
  - 2. Leviton 1221-2 Series.
  - 3. Pass & Seymour PS20AC1 Series.
- B. Description: NEMA WD 1, heavy duty industrial grade, binding screw type for back and side wiring, AC only snap switch with grounded mounting strap, and grounding terminal with green screw.
- C. Toggle Color: As selected by Architect.
- D. Types: Switch shall be single pole, double pole, three-way, or 4-way, as required by the drawings.
- E. Voltage Rating: 120/277 volts, AC.
- F. Current Rating: 20 amperes.
- G. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded.

2.2 RECEPTACLES

- A. Duplex Convenience Receptacle
  - 1. Manufacturers
    - a. Hubbell HBL5362 Series.
    - b. Leviton 5362 Series.
    - c. Pass & Seymour PS5362 Series.
  - 2. Description: Heavy-Duty Federal Industrial Spec Grade with nylon face (smooth), brass strap, brass contacts for side and back wiring, and nylon base.
  - 3. Provide with WR (weather resistant) label when installed in exterior applications per code.
  - 4. Where indicated on the drawings, or per current version of NEC, provide the tamper resistant version with internal shutter system.
  - 5. Color of receptacles shall be as selected by the Architect.
  - 6. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded. Provide similar to Pass & Seymour "Plug Tail" type receptacles.

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- B. Tamper Resistant Duplex Convenience Receptacle
1. Manufacturers
    - a. Hubbell HBL5362TR Series.
    - b. Leviton 5362-SG Series.
    - c. Pass & Seymour TR63 Series.
  2. Description: Heavy-Duty Federal Industrial Spec Grade tamper resistant with nylon face (smooth), brass strap, brass contacts for side and back wiring, and nylon base.
  3. Provide with WR (weather resistant) label when installed in exterior applications per code.
  4. Provide the tamper resistant with internal shutter system.
  5. Color of receptacles shall be as selected by the Architect.
  6. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded. Provide similar to Pass & Seymour "Plug Tail" type receptacles.
- C. Tamper Resistant Duplex USB Charger Receptacle [2 type C]
1. Manufacturers
    - a. Hubbell USB8300C5 Series.
    - b. Leviton T5835-HG Series.
    - c. Pass & Seymour TR20HUSBCC6 Series.
  2. Description: **Hospital Grade** tamper resistant with high-impact resistant thermo plastic construction.
  3. Provide with WR (weather resistant) label when installed in exterior applications.
  4. Provide the tamper resistant with internal shutter system.
  5. Provide with two USB type C ports.
  6. USB charging shall comply with USB BC1.2 battery charging and 3.0 power delivery specifications.
  7. USB charging shall supply minimum 5 amp.
  8. Color of receptacles shall be as selected by the Architect.
  9. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded. Provide similar to Pass & Seymour "Plug Tail" type receptacles.
- D. Tamper Resistant Duplex USB Charger Receptacle [2-type A]
1. Manufacturers
    - a. Hubbell USB8300A5 Series.
    - b. Leviton T5832-HG Series.
    - c. Pass & Seymour TR8300HUSB Series.
  2. Description: **Hospital Grade** tamper resistant with high-impact resistant thermo plastic construction.
  3. Provide with WR (weather resistant) label when installed in exterior applications.
  4. Provide the tamper resistant with internal shutter system.
  5. Provide with two (2) USB type A ports.
  6. USB charging shall comply with USB BC1.2 battery charging and 3.0 power delivery specifications.
  7. USB charging shall supply minimum 5 amp.
  8. Color of receptacles shall be as selected by the Architect.

9. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded. Provide similar to Pass & Seymour "Plug Tail" type receptacles.

E. Tamper Resistant Ground Fault Circuit Interrupter (GFCI) Receptacle

1. Manufacturers

- a. Hubbell GFTR20 Series.
- b. Leviton X7899 Series.
- c. Pass & Seymour 2097TR Series.

2. Description: Federal Specification Grade tamper resistant with high-impact-resistant thermoplastic construction, brass contacts for side and back wiring and LED trip indicator light.
3. GFCI receptacles shall not be connected to protect downstream devices, unless noted otherwise on the drawings. Provide unit designed for installation in a 2-3/4" deep outlet box without adapter, grounding type, Class A, Group 1, per UL 943.
4. Device shall comply with Federal Specification WC596. Devices shall have protection so that if critical components are damaged and ground fault protection is lost, power to receptacle shall be disconnected.
5. Provide with WR (weather resistant) label when installed in exterior applications per code.
6. Provide tamper resistant with internal shutter system.
7. Prewired and plug-in devices shall be acceptable provided device matches specifications and plug-in devices are crimped and welded.

F. Weatherproof Receptacle

1. Consisting of a GFCI receptacle as specified above in an outlet enclosure that is UL listed for wet locations, and meet NEC and OSHA requirements while in use.
2. Exterior-mounted receptacles installed in existing walls and on mechanical units shall have a self-closing weatherproof (in use) cover similar to Pass & Seymour WIUCAST series. Exterior-mounted receptacles installed in new walls shall have a self-closing weatherproof (in use) and be mounted over a recessed box similar to Arlington Industries DSBVR1W series. Paint cover to match adjacent surface with appropriate type of paint. Coordinate color with Architect prior to ordering.

2.3 CORD REELS

A. Manufacturers

1. Appleton (by Emerson) RL5340 w/ RE-PPB power outlet box and RE-PBS-2 ball stop power cord reel or equal by Hubbell or Pass and Seymour.
  - a. Provide cord and plug on reel, and receptacle at ceiling/structure.
  - b. Description: Retractable reel with 50' of wire, rated at 15 amps using #14 AWG wire.
2. Appleton (by Emerson) RL5340 w/ incandescent headlamp and RE-PBS-2 ball stop light reel. Provide with LED bulb or equal by Hubbell or Pass and Seymour.
  - a. Provide cord and plug on reel, and receptacle at ceiling/structure.
  - b. Description: Retractable reel with 50' of wire, rated at 15 amps using #14 AWG wire.

3. NEMA 4X: KH Industries model RTFH3L-WW-B12K. Install using a heavy-duty pivot base.
  - a. Provide at exterior, damp and/or wet locations.
  - b. Provide cord and plug on reel, and receptacle at ceiling/structure.
  - c. Description: Retractable reel with 50' of wire, rated at 20 amps using #12 AWG wire.
  - d. Interior Application: Provide yellow heavy duty non-conductive construction with strain relief double 20A duplex receptacle at end of cord, model PT4DD-520-A.
  - e. Exterior Applications: Provide yellow heavy duty non-conductive construction with strain relief double 20A duplex receptacle with covers at end of cord, model PT4DD-520-AWR.
    - 1) Provide GF protected breaker in panel, and an in-use cover at the receptacle in the ceiling.

#### 2.4 SPECIAL PURPOSE RECEPTACLES

- A. Manufacturers
  1. Hubbell.
  2. Leviton.
  3. Pass & Seymour.
- B. Description: Polarized, grounding type
- C. Device Body: Black nylon
- D. Configuration: As required by the amperage and voltage of the equipment to be connected on the drawings.
- E. Provide equipment cord and caps as required for equipment.

#### 2.5 WIRING DEVICE ACCESSORIES

- A. Wall Plates: Provide wall plates for single and combination wiring devices, 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.
- B. Wall Plates: Provide 302 satin finished stainless steel wall plates throughout the building.
- C. Provide galvanized steel wall plates in unfinished spaces.

#### 2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  1. Cord: Rubber insulated, stranded copper conductors, with type SOW A jacket. Green insulated grounding conductor, and equipment rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.



**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
- B. Verify all receptacle mounting heights before roughing in unless noted. If an outlet is installed in such a location as to be out of proper relation to beams, walls, or finish details of the building, its location shall be corrected by and at the expense of the Contractor under direction of the Architect/Engineer.
- C. Install devices and assemblies plumb and secure only in electrical boxes which have been cleaned of excess building materials, dirt, and debris. Device to be secure tight against wall box and flush with wall plate.
- D. Install switches on latch side of doorways.
- E. Install wall plates when painting is complete.
- F. Do not share neutral conductor on load side of dimmers.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- H. Protect devices and assemblies during painting.
- I. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
- J. Coord reels shall be installed at structure or in ceiling (where architectural drawings indicate a ceiling). Provide all miscellaneous steel as required to support cord reel, both vertically and laterally. When installed in ceiling:
  - 1. Support cord reel so that ceiling is not impacted from pulling cable.
  - 2. Provide power connection to cord reel at ceiling plane to meet NEC.

**3.2 INSTALLATION TO MEET ACOUSTICAL PERFORMANCE**

- A. In order to reduce sound transmission through walls, when devices boxes are installed to serve both sides of the wall, they shall be installed in different stud cavities. Where boxes are found to be installed in the same stud cavity, feeding two different sides of the wall, they will be required to be removed and reinstalled at the contractor's expense.

**3.3 IDENTIFICATION**

- A. The requirements listed below are in addition to the requirements listed in Division 26 "Electrical Identification".
- B. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.

- C. Receptacles: Identify panelboard and circuit number from which served. Use machine printed, pressure sensitive, abrasion resistant label tape on backside of the wall faceplate and durable wire markers or tags within outlet boxes.

### 3.4 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

### 3.6 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726



**SECTION 262813 – FUSES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes cartridge fuses, rated 600 V and less, for use in switches, panelboards, switchboards, controllers, and motor control centers; and spare fuse cabinets.

**1.2 SUBMITTALS**

- A. Product Data: Include dimensions and Manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.

**1.3 QUALITY ASSURANCE**

- A. Source Limitations: Provide fuses from a single Manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

**1.4 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply Manufacturer's ambient temperature adjustment factors to fuse ratings.

**1.5 COORDINATION**

- A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of maximum fuse size.

**1.6 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged in original cartons or containers and identified with labels describing contents.
  - 1. Fuses: Quantity equal to one (1) set for every five (5) installed sets, but not fewer than one set of three of each kind.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.; Busmann Div.
  - 2. Mersen (Ferraz Shawmut).
  - 3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

**2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 FUSE APPLICATIONS**

- A. Main Service: Class L, time delay (601 to 6000A) or Class J, time delay (0 to 600A).
- B. Main Feeders: Class L, time delay (601 to 6000A) or Class J, time delay (0 to 600A).
- C. Combination Starter/Disconnect Switches: Class RK1, time delay.
- D. Disconnect Switches: Class RK1, time delay (30-600A).
- E. Other Branch Circuits: Class J, time delay.

**3.3 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

**3.4 IDENTIFICATION**

- A. The requirements listed below are in addition to the requirements listed in Division 26 "Electrical Identification".

- B. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813



**SECTION 262816 – DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. Disconnect Switches.
- B. Molded-Case Circuit Breakers and Switches.
- C. Enclosures.

**1.2 REFERENCES**

- A. FS W F 870 Fuse Holders (For Enclosed Cartridge Fuses).
- B. FS W S 865 Switch, Box, (Enclosed), Surface Mounted.
- C. NEMA KS 1 Enclosed Switches.

**1.3 SUBMITTALS**

- A. Include outline Drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Square D Company.
- B. Siemens.
- C. Eaton (Cutler Hammer).
- D. General Electric by ABB.
- E. No Other Manufacturers will be considered.

**2.2 HEAVY DUTY TYPE FUSED AND NON-FUSED DISCONNECT SWITCHES**

- A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- B. Lugs shall be mechanical type, front removable and UL listed for 60°C or 75°C conductors in switches rated 30 through 100 ampere, 75°C conductors in switches rated 200 through 1200 ampere, copper conductors.
- C. Switches rated over 1200 amperes shall be provided as switchboard sections, with all applicable accessories.



- D. All current carrying parts shall be plated to resist corrosion.
- E. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
- F. Switches shall have provisions for a field installable electrical interlock.
- G. Switch operating mechanism shall be quick make, quick break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- H. The operating handle shall be an integral part of the box, not the cover.
- I. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
- J. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- K. The enclosure shall have ON and OFF markings on the cover to clearly identify the position of the switch.
- L. All switches shall have provisions to lock the operating handle in the OFF position.
- M. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
- N. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R fuses (30 through 600 ampere switches employing appropriate fuse rejection schemes).
- O. Switch Accessories:
  - 1. Provide the following where required/indicated on the documents:
    - a. Where switches are designated to be used as service entrance, the switch shall be labeled for such use.
    - b. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
    - c. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
    - d. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
    - e. Where fused switches are designated to have type "R" fuses, the switch shall be provided with rejection clips.
    - f. Provide fuse clip adaptors as required to accommodate smaller fuses when required.
    - g. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Provide contact rating as required to accommodate application.

**2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES**

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 60 deg C 125 ampere circuit breakers and below and 75 deg C over 125 ampere.
- F. Switches rated over 1200 amperes shall be provided as switchboard sections, with all applicable accessories.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response, when ground-fault is required or indicated.
- I. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Provide where indicated or required by code.
- J. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip). Provide where indicated.
- K. Features and Accessories:
  - 1. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 2. Ground-Fault Protection: Comply with UL 1053; integrally mounted type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 4. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 5. Electrical Operator: Provide remote control for on, off, and reset operations.

2.4 ENCLOSURES

- A. Switch and breaker enclosure shall be NEMA 1 unless otherwise on the Drawings or required by the NEC in accordance with the project conditions.
  - 1. Exterior switches and breakers shall be rated NEMA 3R, unless noted otherwise.
  - 2. Kitchen and wash-down areas shall be provided with NEMA 4X with stainless steel enclosure, unless noted otherwise.
- B. The enclosure shall be finished with Gray baked enamel paint which is electrodeposited on cleaned, phosphate pretreated steel (Type 1), or Gray baked enamel paint which is electrodeposited on cleaned, phosphate pretreated galvanized steel (Type 3R).
- C. Tangential knockouts shall be provided to facilitate ease of conduit entry for switches rated 30 through 200 amperes.
- D. Enclosures for Type 3R switches through 200 amperes shall have provisions for interchangeable bolt on hubs in the top end wall.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches to meet N.E.C. working clearance requirements.
- B. Install fuses in fusible disconnect switches.

3.2 IDENTIFICATION

- A. The requirements listed below are in addition to the requirements listed in Division 26 "Electrical Identification."
- B. Provide labeling on the exterior of each disconnect switch Stating the following:
  - 1. What the piece of equipment is fed from the switch.
  - 2. Where the piece of equipment is fed from the switch.
  - 3. Size, type and quantity of fuses within cabinet.

3.3 FIELD QUALITY CONTROL

- A. Subsequent to completion of installation of disconnects, energize circuits and demonstrate capability and compliance with requirements. Demonstrate switch operation through six (6) opening/closing cycles with circuit unloaded. Open each switch enclosure to display interior, mechanical and electrical connections and fuse installation, and for verification of type and rating of fuses installed. Where possible, correct deficiencies at project site, then retest or demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION 262816

**SECTION 265100 – LIGHTING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes interior LED lighting fixtures, LED lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.

**1.2 SUBMITTALS**

- A. Product Data: For each type of lighting fixture indicated, provide typical cutsheets. Include data on features, accessories, and the following:

- 1. Light output in lumens, color temperature (CCT), color rendering index (CRI) and energy efficiency data.
- 2. Lighting fixture accessories.
- 3. Dimensions of fixtures.
- 4. Light Pole Bases (when contractor elects to provide precast concrete bases in lieu of cast in place).

- B. Exterior Fixture Performance

- 1. Site lighting is based on the manufacturers and distribution patterns specified. It shall be the Contractor's responsibility to review all "approved substitute" manufacturers to match the lighting levels achievable with the basis of design.
- 2. If requested, the Contractor shall supply the Engineer with a 10'x10' lighting level plot plan of the site using the proposed approved alternate manufacturer for review. If the alternate manufacturer cannot meet light levels within Engineer acceptable limits, the Contractor will be required to select another manufacturer from the approved substitute list.

- C. Coordination: The electrical contractor shall be responsible to coordinate all light fixtures with ceiling installer before installation of ceiling grid. The electrical contractor shall also coordinate light fixture installation with HVAC and plumbing contractor for installation of piping and ductwork. Should there be any conflicts, they should be brought to the attention of the Architect/Engineer prior to the installation of the ceiling grid. Any conflicts not brought to the attention of the Architect/Engineer before installation of ceiling, the electrical contractor shall bare all costs associated with rework to install light fixtures, piping, ductwork, ceiling grid, etc.

**1.3 QUALITY ASSURANCE**

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.4 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.
- B. Lighting Control: Verify compatibility of lighting controls (analog dimmers and digital systems) with lighting fixtures to be installed. Where controls are not compatible with the lighting to be installed, bring to the attention of the Architect/Engineer in writing prior to ordering lighting fixtures or controls.

1.5 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect/Engineer prior to the start of luminaire installation.
- B. Where aimable fixtures are specified (i.e. flood lights), fixtures shall be aimed at night, and presented to the Architect/Engineer for review prior to final approval.

1.6 WARRANTY

- A. Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within the project specified warranty period.
- B. Manufacturer warranty: Contractor shall ensure manufacturer published warranty furnished with the luminaires remain in-tact through the project as well as the project warranty period. Any luminaires that are damaged during the project shall be replaced at no additional cost to the owner in order to ensure maintenance of the product warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide from manufacturers as specified in the Lighting Fixture Schedules or on the drawings.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

**2.3 FIXTURES AND FIXTURE COMPONENTS, GENERAL**

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
  - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
  - 2. Lens Thickness: 0.156 inch minimum, unless greater thickness is indicated.
- F. Metal Finishes: Variations in finishes are unacceptable in the same piece, or in adjacent fixtures.
  - 1. Exterior luminaires shall be provided with the same finish, regardless of manufacturer. Custom finishes must be provided were required to ensure same finish.
  - 2. Pole light heads and poles shall match. Color chips and custom finishes shall be applied to ensure they match, regardless of manufacturer.

**2.4 LED DRIVERS**

- A. Provide low-energy LED drivers, capable of operating the LEDs indicated. Drivers shall operate at an input voltage between 120 to 277 VAC at an input frequency of 60 Hz +/- 10%. Light output shall remain constant for line voltage fluctuations within the range described. Drivers shall comply with EMI and RFI limits set by the FCC (CFR 41 Part 18) for non-residential applications and not interfere with normal electrical equipment. Drivers shall meet applicable ANSI standards and must be UL listed with the fixtures. In order to maximize combability, drivers shall provide 0-10V dimming operation, unless noted otherwise.
  - 1. Where fixtures are connected to a switching device on the drawings, the 0-10V terminations shall remain unconnected.
- B. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.

**2.5 BATTERY POWERED EMERGENCY LIGHTING UNITS**

- A. Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate lamp(s) continuously upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Test Push-Button and Indicator Light: Visible and accessible when fixture installed in final location.
  - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
4. Battery: Provide type as specified.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.6 EXIT SIGNS

- A. General Requirements: Comply with UL 924 and the following:
1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
  2. Internally Lighted Signs: As follows:
    - a. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

## 2.7 LAMPS

- A. LED lamps shall comply with the LM-79 and LM-80 standards and be provided to meet the following minimum specifications:
1. Recessed 1'x4', 2'x2' and 2'x4' fixtures: minimum 50,000 hours at 70% lumen output.
  2. Recessed downlights: minimum 50,000 hours at 70% lumen output.
  3. Linear pendant fixtures: minimum 70,000 hours at 80% lumen output.
  4. Exterior fixtures: minimum 50,000 hours at 70% lumen output.
- B. LED lamps shall be rated as follows, unless specified otherwise:
1. Interior luminaires:
    - a. CCT: 4100K nominal.
    - b. CRI: 80% minimum.
  2. Exterior luminaires:
    - a. CCT: 4100K nominal.
    - b. CRI: 70% minimum.

**2.8 FIXTURE SUPPORT COMPONENTS**

- A. Single-Stem Hangers: ½-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, ½-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- C. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- D. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- E. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.
- F. Independent Support Anchors: Anchors shall be on every fixture at the four (4) opposite corners. The contractor is required to independently support all recessed 1'x4', 2'x2', 2'x4', 4'x4', 2' diameter or larger fixture from all four corners. Circular fixtures smaller than 2' diameter, linear slot fixtures, etc. shall be support from at least two (2) opposite corners. Provide additional supports as recommended by the manufacturer.
- G. Ceiling support steel for light fixtures: Support steel (unistrut) shall be installed to provide additional support for light fixtures from ceiling grid. Unistrut shall be installed above ceiling grid T-bars where the weight of the light fixtures require additional ceiling supports. Unistrut shall be supported independently from ceiling system.

**2.9 FINISHES**

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
- B. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
- C. Metallic Finish: Corrosion resistant.

**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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 TEMPORARY LIGHTING**

- A. The use of permanent lighting shall not be used for temporary lighting, unless approved, in writing, by the Architect/Engineer.



**3.3 INSTALLATION**

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings. Fixtures shall be independently supported from building structure from all four corners of recessed fixtures including 2x4, 1x4, 2x2, 4x4, etc. and from opposite corners from recessed downlight and 1x1 fixtures to building steel. Wire shall be galvanized steel and rated for fixture, but not less than 14 gauge. Braided wire shall be acceptable.
  - 1. Fixtures must be tied to structure so that failure of a single wire does NOT constitute failure of the independent support (i.e. at least two (2) wires must be tied to structure independently).
- C. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
- D. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Suspended Fixture Support: As follows:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Chain Hung: Suspend with jack chain from structure.
  - 4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.
  - 5. Do no support suspended fixtures from grid. Fixtures must be supported from building structure.
- F. Light fixtures shall be installed over junction boxes so they can be removed at a later date to access the wiring in the junction box.
- G. Undercabinet Lighting: When installing undercabinet lighting, take care to hide all wiring. If there is a valance under the cabinet, wiring may exit the wall below the cabinet, and be run tight to the backside of the valance. If there is no valance, wiring shall exit the wall within the cabinet at a lower corner, run along the edge of the bottom shelf to the front of the cabinet to feed the end of the undercabinet light fixture. All exposed wiring shall be MC cable, and be tightly trained using straps and mechanical fasteners.
- H. Where digital or analog dimming devices are indicated to control light fixtures, the required low and/or line voltage wiring shall be provided to control the fixture. Any and all additional accessories required shall be provided in their entirety.
- I. Bollard Luminaires: Align units for optimum directional alignment of light distribution.
  - 1. Install on concrete base with top flush with grade or surface at luminaire location, unless noted otherwise. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.
- J. Ground-Mounted Luminaires: Aim toward building elements. Coordinate final aiming with Architect.

1. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Provide 1" chamfer around concrete base. Cast conduit into base, and finish by troweling and rubbing smooth.

### 3.4 CONNECTIONS

- A. Ground equipment.
- B. Furnish and install code compliant fixture disconnecting devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Tests: As follows:
  1. Verify normal operation of each fixture after installation.
    - a. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- C. Corrosive Fixtures: Replace during warranty period.

### 3.6 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities. Inform Architect/Engineer when aiming fixtures.

END OF SECTION 265100



**SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This section includes metallic cable trays. Types of cable trays in this section include the following:
  - 1. Ladder cable tray
- B. Cable tray support devices are specified herein.
- C. Cable trays for installation of low voltage systems 24V and below, not including life safety (fire alarm) or power systems.

**1.2 DEFINITIONS**

- A. Refer to NEMA Standard VE 1 for definitions of cable tray terminology used in this section.

**1.3 REFERENCES**

- A. ASTM A 510 – General Requirements for Wire Rods and Coarse Rod Wire, Carbon Steel.
- B. ASTM B 633 – Electrodeposited Coatings of Zinc on Iron and Steel.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division-1 Specification Sections:
  - 1. Product Data for cable tray products.
  - 2. Shop Drawings: Layout floor plans and elevations showing coordination of cable tray system. Designate components and accessories including clamps, brackets, hanger rods, splice plates, connectors, expansion joint assemblies, straight lengths, and fittings. Show accurately scaled components and spatial relationships to adjacent equipment. Show tray types, dimensions, and finishes. Coordinate and route tray around all mechanical ductwork, piping, electrical conduits and lighting fixtures.
  - 3. The Contractor shall be responsible to provide layout drawings which show cable tray layout, routing and elevation through each space within the building. This Contractor shall be responsible to have all other trade Contractors sign off on the drawings to show the drawings have been coordinated with each trade. This Contractor shall bare all costs related to moving or relocating cable should a conflict arise between contractors if layout drawings are not submitted and signed off by all other prime trade contractors.
  - 4. Factory Test Reports: Certified copies of factory test reports performed in conformance with NEMA Standard VE 1 on cable trays of types and size specified for this project.

1.5 QUALITY ASSURANCE

- A. UL and NEMA Compliance: Cable trays and components shall be classified by UL and comply with NEMA Standard VE 1, "Cable Tray Systems."
- B. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Cable trays and components shall be listed and labeled by a NRTL and comply with NEMA Standard VE 1, "Cable Tray Systems." The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- D. Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

PART 2 - PRODUCTS

2.1 LADDER CABLE TRAY

A. Manufacturers

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Eaton
  - b. Legrand
  - c. Cope
  - d. Chalfant Manufacturing Company
  - e. Mono-Systems
  - f. ABB

B. General Requirements

- 1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
- 2. Width: **24 inches** unless otherwise indicated on Drawings.
- 3. Minimum Usable Load Depth: **4 inches** unless otherwise indicated on Drawings.
- 4. Straight Section Lengths: 10 feet, except where shorter lengths are required to facilitate tray assembly.
- 5. Rung Spacing: 9 inches o.c.
- 6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
- 7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
- 8. No portion of the rungs shall protrude below the bottom plane of side rails.
- 9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
- 10. Fitting Minimum Radius: 12 inches.
- 11. Class Designation: Comply with NEMA VE 1, Class 12B.
- 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
- 13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:

1. Steel: Provide hot-dip galvanized finish, with galvanized, ASTM B633 hardware.
2. Aluminum: Provide aluminum tray with stainless steel hardware (to avoid electrolysis).

## 2.2 SUPPORTS AND CONNECTORS

- A. Cable tray supports and connectors, including bonding jumpers shall be as recommended by cable tray manufacturer.
- B. Cable tray shall be trapeze or wall supported. Center hung cable trays shall not be acceptable.

## 2.3 FASTENERS FOR SUPPORTS

- A. Fasteners to connect cable tray supports to the building structure shall be as follows:
  1. Trapeze Hangers.
  2. Brackets and Support Kits.
  3. Expansion Anchors.
  4. Electro-Galvanized Zinc All Thread Rods.

## 2.4 ACCESSORIES

- A. **Provide drop-outs when cable tray is installed over data racks to protect cables as they drop to data racks.**
- B. Wherever the tray is exposed, and visible from below, provide a solid bottom plate. Tray and plate to be painted as directed by the architect.
- C. Provide dividers where indicated. Install dividers centered in tray, unless noted otherwise.

## 2.5 FIRE STOPPING

- A. General: Materials shall be UL listed and labeled and FM approved for fire ratings consistent with penetrated barriers. The Contractor shall be responsible to provide fire rated sleeves for where cable tray penetrates fire rated floors or walls. Sleeve capacity, at 40% fill shall match cable tray capacity. Contractor may install 4" conduits sleeves or rectangular sleeve with fire pillow at their discretion.
- B. Refer to Division 26 "Common Requirements – Electrical," for additional fire stopping requirements.

## 2.6 WARNING SIGNS

- A. Lettering: Provide the following factory label for all cable tray sections: "WARNING! NOT TO BE USED AS WALKWAY."
- B. Materials and Fastening: Conform to Section "Electrical Identification."

PART 3 - EXECUTION

3.1 INSTALLATION OF CABLE TRAY SYSTEMS

- A. Install cable trays in accordance with equipment manufacturer's written instructions.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges of cable trays.
- E. Support cable tray independently from the building structural components. Support cable tray using center or trapeze style hangers.
- F. Conform to manufacturer's recommendations for selection and installation of supports.
- G. Strength of each support including fastenings to the structure shall be adequate to carry present and future load multiplied by a safety factor of at least four or 200 lbs., whichever is greater.
- H. Support Locations: Locate supports in accordance with the recommendations of NEMA Standard VE 1 and VE 2.
- I. Installation of supports shall be in accordance with cable tray manufacturer's written instructions and the recommendations of NEMA Standard VE 1 and VE 2.
- J. Fastening Supports: Unless otherwise indicated, fasten cable tray supports securely to the building structure as specified in Division-26 Section "Supporting Devices."
- K. Support at Connections to Equipment: Where cable trays connect to equipment, provide flanged fittings fastened to the tray and to the equipment. Support the tray separately. Do not carry the weight of the tray on the equipment enclosure.
- L. Provide expansion fittings where cable tray crosses building expansion joints.
- M. Direction Changes: Make changes in direction of cable tray with standard cable tray fittings.
- N. Locate cable tray as required to route cables across data closets and in corridors as needed and as otherwise indicated.
- O. Firestopping: Where cable trays penetrate fire and smoke barriers including walls, partitions, floors, and ceilings, install fire- stopping at penetrations after cables are installed.
  - 1. At fire and smoke barriers, the contractor shall provide a quantity of 4" conduits with a 40% fill capacity that matches the rated fill capacity of the cable tray to penetrate the barriers. All fire and smoke barriers are indicated on the architectural drawings and specifications.
- P. Sleeves for Future Cables: Install capped sleeves for future cables through fire stopped cable tray penetrations of fire/smoke barriers.
- Q. Working Space: Install cable trays with sufficient space to permit access for installing cables.

**3.2 GROUNDING**

- A. Electrically ground cable trays and ensure continuous electrical conductivity of cable tray system. Use tray as an equipment ground conductor for itself only, not for connected equipment. Grounding connection shall be minimum #6 AWG.

**3.3 SYSTEMS INSTALLED IN CABLE TRAY**

- A. Cable tray may be used for data, building intercom, security, BAS, and other non-life safety low voltage systems.
- B. Under no circumstances may fire alarm and other life safety equipment be installed in cable trays.
- C. Under no circumstances may any power lines (over 24VAC) be installed in cable tray. Power conduits shall be kept minimum 12" from cable tray wherever possible.

**3.4 FIELD TESTING**

- A. Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.

**3.5 CLEANING AND FINISH REPAIR**

- A. Upon completion of installation of cable trays, inspect trays, fittings, and accessories. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 270536





**SECTION 271500 – COMMUNICATIONS CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide a complete, tested, cable distribution system for data network system (local area network). The data distribution system shall include fully terminated fiber optic cable(s) and UTP station cables.
- B. Fiber Optic Cables: Fiber optical cables shall be installed from the existing data closet (located in mezzanine near motorcycle/marine repair) to data closet located new welding building, terminating all fiber optic strands in termination enclosures (patch panels). Refer to Intercommunications /clock system Specification Section 275123 for fiber optic cables required for intercom/clock/paging system.
- C. UTP Cables: UTP cables shall be routed to each data outlet location.
- D. Provide specific details consistent with the contract documents as required to complete shop drawings for data cable systems including detailed documentation for Owner review and detailed documentation of as-built conditions.

**1.2 APPLICABLE STANDARDS**

- A. TIA/EIA-569-A: "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. TIA/EIA-568-C.2: "Commercial Building Telecommunication Standard" with all addendums.
- C. ISO/IEC 11801 Ed. 2.0 (Class E)
- D. TIA/EIA-TSB 67: "TIA/EIA Telecommunications Systems Bulletin, Additional Transmission Specifications for Unshielded Twisted-Pair Cabling Systems."
- E. TIA/EIA-568-3: "Optical Fiber Cabling Components Standard," with all addendums.
- F. TIA/EIA-455-61: "FOTP-61, Measurement of Fiber or Cable Attenuation Using An OTDR."
- G. IEEE 802.3: "Carrier Sense Multiple Access with Collision Detection."
- H. IEEE 802.3ab: Gigabit transmission over UTP
- I. TIA/EIA-606: "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- J. TIA/EIA-607: "Commercial Building Grounding and Bonding Requirements for Telecommunications."
- K. TIA/EIA-455-171-D: "Standard Test Procedures for Fiber Optic Cables."
- L. TIA/EIA-4750000-B: "Generic Specification for Fiber Optic Connectors."
- M. TIA/EIA-475E000: "Sectional Specification for Fiber Optic Connectors Type BFOC/2.5."
- N. TIA/EIA-604-X: "Fiber Optic Connector Intermateability Standards (FOCIS)."

1.3 REGULATORY REQUIREMENTS

- A. All work shall be performed in accordance with the latest revisions of the following standards and codes:
  - 1. Uniform Construction Code (UCC)
  - 2. National Electrical Code (NEC)
  - 3. Standards as previously listed
  - 4. The supplied manufacturers structured cabling system installation guidelines.
- B. Governing Codes and Conflicts: If the requirements of this section or the Project Drawings exceed those of the governing codes and regulations, then the requirements of this section and the Drawings shall be construed to permit work not conforming to all governing codes and regulations.

1.4 SUBMITTALS

- A. Documentation:
  - 1. The name of the person who will act as the Contractor's official contact with the Owner/Engineer.
  - 2. A copy of an RCDD certificate from a full-time staff member.
  - 3. Complete manufacturer's product literature for all cable, patch panels, cable supports, cable labels, outlet devices, and other products to be used in the installation. Cabling and outlets must show compliance with the performance criteria specified herein. In addition, whenever substitutions for recommended products are made (pre-approved prior to bid by Owner/Engineer), samples and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
  - 4. Shop Drawings:
    - a. The Contractor shall submit scaled drawings of all IDF/MDF rooms with backboard layouts showing hardware frame placements and rack locations with wire management. The name/number of the room shall be included. The contractor must show dimensions for LAN network equipment.
    - b. The Contractor shall submit individual rack layouts for Owner review indicating all hardware as well as Owner furnished network electronics and servers. Coordinate with Owner network electronic and server dimensions, etc.
  - 5. Proposed TIA/EIA Category cable matching specified, and fiber optic cable test result forms. Provide complete product information on proposed meter to be used and verification that meter is acceptable for use to provide warranty as specified.
  - 6. Certifications: Contractor must be pre-certified by the manufacturers of the products that comprise a partnership guaranteeing 20-year performance. Submit copy of certifications and 20-year performance warranty. Contractor must show record of at least five (5) previous projects of this type with required warranties.
  - 7. Warranty: Warranty must guarantee all performance values in accordance with proposed TIA/EIA Category cable matching specified. The warranty shall include application assurance beyond Gigabit Ethernet and future 500MHz applications. Additional warranty must guarantee performance of the fiber optic cable.
  - 8. 3rd party certification of Channel and component compliance meet or exceeding the performance criteria herein.
- B. Labeling:

1. The Contractor shall work with the Owner's IT department to verify the labeling to be used throughout the building. Once the labeling has been determined, the Contractor shall submit the labeling scheme to the Engineer for review. The submittal shall include a sign-off by the Owner's IT department.
2. Racks and cabinets shall be labeled with closet designation with self-adhesive labels.

C. Rack Layouts:

1. The Contractor shall work with the Owner's IT department to verify the rack layouts to be used throughout the building. Once the layouts have been determined, the Contractor shall submit the layout drawings to the Engineer for review. The submittal shall include a sign-off by the Owner's IT department.

- D. When preparing submittals and any required final drawings/labeling, use a room number schedule generated by the architect and/or the Owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers.

1.5 FUNCTION AND OPERATION

- A. The intended function of the data communications cable system is to transmit data signals from a central location to the individual data outlet locations. Upon completion of the work outlined in this specification, the system shall be capable of transmitting data signals at a rate of 1Gbps, and future applications.
- B. The multimode optical fiber cable system shall be capable of transmitting laser signals at 10 Gigabit Ethernet (10 GbE) operating at 850 nm (10GBASE-SR) for a minimum distance as specified below (IEEE 802.3 Performance). The multimode optical fiber cable system shall also be capable of transmitting Gigabit Ethernet (GbE) operating at 850 nm (1000BASE-SX) for a distance as specified below and 1300 (1000BASE-LX) nm for a distance as specified below.
- C. The single-mode optical fiber cable system shall have a cutoff wavelength of less than 1260nm.
- D. Work station cable, from the MDF/IDF to the work area, shall be installed in accordance with TIA/EIA-568-C.2 specified installation practices, TIA/EIA-TSB-67 recommended installation practices, TIA/EIA-569, and the manufacturer specified installation practices.
- E. The Permanent Link shall be tested for TIA Category standards. Channel Manufacturer or Partners must submit 3rd party verification of category performance using "WORST CASE" 4 connector model. "Typical" or "Average" measurements will NOT be accepted.

1.6 PROJECT COMPLETION

- A. As a condition for project acceptance, the Contractor shall submit the following for review and approval:
1. Inspection and Test Reports: During the course of the Project the Contractor shall maintain an adequate inspection system and shall perform such inspections to ensure that the materials supplied and the work performed conform to Contract requirements. The Contractor shall provide written documentation which indicates materials acceptance testing was conducted as outlined Part 3 below. The Contractor shall also provide documentation which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion for Owner/Engineer analysis.

2. A manufacturer warranty shall be provided by the Communication Systems installer. This warranty shall include defects in material and workmanship. Warranty shall also cover applications assurance beyond 1000BaseT. The warranty period shall begin at the date of Substantial Completion. Quality and workmanship evaluation shall be solely by the Owner/Engineer and designated representatives.

B. Acceptable Cable Tester

1. Refer to part 3 for tester information.

1.7 SYSTEM INSTALLER

- A. The Owner reserves the right to exercise its discretion to require the contractor to remove from the project any such employee of the contractor to be incompetent, careless, or insubordinate.
- B. Where applicable, the installer must be licensed and bonded in the state.
- C. Installer must have RCDD on staff as a full-time employee.
- D. Prior to bid date, the installer must be certified by the manufacturer of the cabling components he intends to use.
- E. All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

1.8 ABBREVIATIONS AND DEFINITIONS

- A. MDF/MCF – Main Distribution Frame/Main Cross-Connect Frame.
- B. IDF/ICF – Intermediate Distribution Frame/Intermediate Cross-Connect Frame consisting of station wire terminals, riser cable terminals, and various equipment.
- C. UTP – Unshielded Twisted Pair (telecommunications station cable).

1.9 MINIMUM WARRANTY

- A. The Cabling System shall meet the performance requirements of the ANSI/TIA/EIA-568-C.2 standard and TIA/EIA Telecommunications Systems Bulletin 67. The warranty on the material, services, and operation of the cabling system to this specification must be for a period of at least 20 years.
- B. The warranty must include the following statements regarding the cabling system:
  1. "will support and conform to TIA/EIA-568-C.2 specifications covering ANY CURRENT OR FUTURE APPLICATION which supports transmission over a properly constructed horizontal cabling system premises network which meets the channel and/or basic link performance as described in TIA/EIA-568-C.2 and TIA/EIA TSB67 for category cable systems."
  2. "will be free from defects in material or faulty workmanship."
- C. Warranty must also include the fiber optic backbone for the complete warranty duration.

- D. The warranty must be provided by the hardware manufacturer and must be fully executed prior to project closeout.
- E. Individual warranties shall be provided for horizontal and backbone wiring. They shall comply with the performance specifications for each wiring system.

**PART 2 - PRODUCTS**

**2.1 GENERAL WIRING**

- A. The cabling shall be installed per requirements of these specifications utilizing materials meeting all applicable TIA/EIA standards for Category cable specified.
- B. Materials shall meet the TIA/EIA 568A category specification matching specified. Must supply 3rd party verification of this performance as specified herein. In some cases, specific materials are called out to maintain a uniformity of application across all installations.
- C. All installed wire shall be tested and labeled 100% good after installation by the installer.
- D. All cabling, outlets, and termination patch panels used for the Category cable specified data system may be provided by a single manufacturer and shall be certified as part of the 20-year minimum warranty. Where the installer chooses to use one (1) manufacturer for cabling and a different manufacturer for the outlets and termination patch panels, the two (2) manufacturers must prove to have compliant interconnecting hardware and shall be certified as part of the 20-year minimum warranty. The components manufacturer shall take responsibility for the end-to-end system performance certification.
- E. All components, modules, adapters, and fittings required for a complete and first-class installation shall be provided whether or not enumerated herein. Model numbers given are meant to set a standard for performance criteria and general style of device. It is the contractor's responsibility to verify the completeness and proper fit of devices including depth and necessary cable bend radius within raceways, and compatibility of outlets in surface raceway or floor boxes before installation.
- F. All device colors shall be as per the TIA/EIA Standards and as approved by the Owner and/or Engineer before installation.
- G. All products shall be new, and brought to the job site in original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
  - 1. For Copper Cable
    - a. CM: Communications Cable
    - b. CMP: Plenum Rated Communications Cable
    - c. CMR: Riser-rated Communications Cable
  - 2. For Fiber Optic Cable
    - a. OFN: Communications
    - b. OFNP: Plenum Rated
    - c. OFNR: Riser-rated

- H. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket which would indicate possible problems. Damaged cable, or any other components failing to meet specifications shall not be used in the installation.

## 2.2 CATEGORY 6 HORIZONTAL CABLING

- A. Manufacturers for Category 6/ISO Class E Cable – ISO 9001 Certified
1. Belden GigaFlex 4800LX
  2. Mohawk GigaLan
  3. Berk-Tek LANmark 2000
  4. Hitachi Supra 660
  5. General Cable GenSpeed 6500 Premium
  6. CommScope Systimax 2071 GigaSpeed XL
  7. Hubbell Nextspeed Cat 6 Enhanced
  8. Superior Essex NextGain
- B. Description: Unshielded twisted pair cable, Category 6/ISO Class E, CMP listed, for use with IEEE Std. 802.3 network, and TIA/EIA-568 compliant using 4 pairs, 23/24 AWG solid copper conductors all 4 pairs FEP insulated, colored plenum rated jacket, meeting or exceeding the category 6/ISO Class E requirements, tested to at least 500MHz. **Provide different color jackets for different cable systems including, but not limited to in-wall data, wireless access points, intercommunications system, security/CCTV and projector connections. Verify with Owner to match existing system cable colors prior to ordering.**
- C. All 4-pair station cables shall:
1. Conform to TIA/EIA-568-C.2.
  2. Be part of the UL LAN Certification and Follow-up Program.
  3. Tested and approved by ETL or similar independent testing facility.
- D. The copper cabling provided for each data outlet shall be one 4-pair UTP Category 6/ISO Class E cable per jack. For example, where multiple jacks are indicated at a single location, each jack shall have its own dedicated 4-pair UTP cable.
- E. The Category 6/ISO Class E 4-pair UTP cable, must be UL Performance Level Tested and 3rd party verified that the cable meets or exceeds these specifications.

## 2.3 CATEGORY 6 STATION HARDWARE (Outlets)

- A. Manufacturers for Category 6/ISO Class E Cable – ISO 9001 Certified.
1. Panduit MiniCom TX-6
  2. Hubbell Nextspeed Xcelerator
  3. Ortronics Clarity TracJack
  4. The Siemon Company Max 6 Modules
  5. Leviton eXtreme
- B. Data Outlets - Category 6 modular jack with single gang 4-port angled faceplate for “gravity-feed” outlets at wall mounted locations. Provide quantity of data outlets at the locations as indicated

on the drawings. Provide blank inserts for unused openings in faceplate. Flush type outlets shall be provided at floor boxes.

- C. Jacks shall be high quality Category 6/ISO Class E 8-position modular jack with mechanical stress relief for cable. Jacks shall provide dual color code to allow both T568A and T568B wiring on the same jack. Jacks shall be terminated using TIA/EIA-568-C.2 requirements for Category 6 connecting hardware. Provide four (4) termination tools.
- D. Faceplates shall match manufacturer style for modular jack outlets at all locations. Color and material (nylon or stainless steel) shall match wiring devices in the area being installed. Faceplates shall accommodate color-coded icons for different applications and a separate location for labeling.
- E. Where outlets are installed in surface raceway, jacks must be compatible with the surface raceway faceplate and the surface raceway depth. Faceplate color shall match raceway color. Where outlets are installed in floor boxes, jacks must be compatible with the floor box faceplate or mounting strap.
- F. All terminating hardware for 4-pair Category 6/ISO Class E cabling shall:
  - 1. Conform to TIA/EIA-568-C.2 - Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section.
  - 2. Be part of the UL LAN Certification and Follow-up Program.
  - 3. Meet or exceed the specifications for Category 6/ISO Class E Channel.
- G. Additional electrical and mechanical specifications are:
  - 1. Insulation resistance: 500 MW minimum.
  - 2. Dielectric withstand voltage: 1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
  - 3. Contact resistance: 20 mW maximum.
  - 4. Current rating: 1.5 A at 68 deg F (20 deg C) per IEC Publication 512-3.

**2.4 CATEGORY 6 CHANNEL – PERFORMANCE REQUIREMENTS**

- A. The Channel performance levels shall not be less than the minimum values shown in the following table.

Frequency MHz	Pair-To- PairNEXT Loss(dB)	Pair-To- PairELFEXT Loss(dB)	Power SumNEXT Loss(dB)	Power SumELFEXT Loss(dB)
1	80.3	73.8	78.3	70.8
10	65.3	53.8	63.3	50.8
31.25	57.9	43.9	55.9	40.9
100	50.3	33.8	48.3	30.8
200	45.8	27.7	43.8	24.7
250	44.3	25.8	42.3	22.8



- B. The Channel performance levels shall not be less than the minimum values shown in the following table.

Frequency MHz	Attenuation (dB)	Pair-To- PairACR(dB)	Power SumACR(dB)	Return Loss(dB)
1	2.0	78.5	76.5	20.0
10	5.9	60.0	58.0	25.0
31.25	10.6	48.3	46.3	23.6
100	19.7	31.6	29.6	20.1
200	28.8	18.0	16.0	18.0
250	32.6	12.7	10.7	17.3

- C. The channel performance shall be based on a 4 connector, worst pair, independently tested solution.

## 2.5 SINGLE-MODE FIBER OPTIC CABLE SPECIFICATIONS - Indoor

- A. Manufacturers - ISO 9001 Certified

1. Berk-Tek
2. Corning Cable Systems
3. Mohawk
4. CommScope
5. General Cable
6. Superior Essex
7. Hubbell

- B. Fiber must be manufactured using Corning or Alcatel glass for 10 Gigabit Ethernet link length of 2000 meters at 1310nm.

- C. Description: Fiber Optic Cable shall be riser rated UL listed type OFNP and UL listed for indoor applications; single mode strands as indicated on the drawings, each with a color-coded PVC buffer. Provide strand counts between closets as indicated on drawings.

- D. Provide plenum rated steel or aluminum armored cable.

## 2.6 MULTI-MODE FIBER OPTIC CABLE SPECIFICATIONS - Indoor

- A. Manufacturers - ISO 9001 Certified

1. Berk-Tek
2. Corning Cable Systems
3. Mohawk
4. CommScope
5. General Cable
6. Superior Essex
7. Hubbell

- B. Fiber must be manufactured using Corning or Alcatel glass for 10 Gigabit Ethernet link length of 300 meters (850 nm) and meet OM3 specifications.

- C. Description: Fiber Optic Cable shall be UL listed type OFNP; 50/125-micron multimode fibers for 10 Gigabit Ethernet transmission, each with a color-coded PVC buffer. Provide strand counts between closets as indicated on drawings.
- D. Provide plenum rated steel or aluminum armored cable.

**2.7 SINGLE-MODE FIBER OPTIC CABLE SPECIFICATIONS - Outdoor**

- A. Manufacturers - ISO 9001 Certified
  - 1. Berk-Tek
  - 2. Corning Cable Systems
  - 3. Mohawk
  - 4. CommScope
  - 5. General Cable
  - 6. Superior Essex
  - 7. Hubbell
- B. Fiber must be manufactured using Corning or Alcatel glass for 10 Gigabit Ethernet link length of 2000 meters at 1310nm.
- C. Description: Fiber Optic Cable shall be riser rated UL listed for indoor/outdoor applications type OFNP; single mode strands as indicated on the drawings, each with a color-coded PVC buffer with DryGel water blocking. Provide strand counts between closets as indicated on drawings.
- D. Provide plenum rated steel or aluminum armored cable.

**2.8 MULTI-MODE FIBER OPTIC CABLE SPECIFICATIONS - Outdoor**

- A. Manufacturers - ISO 9001 Certified
  - 1. Berk-Tek
  - 2. Corning Cable Systems
  - 3. Mohawk
  - 4. CommScope
  - 5. General Cable
  - 6. Superior Essex
  - 7. Hubbell
- B. Fiber must be manufactured using Corning or Alcatel glass for 10 Gigabit Ethernet link length of 300 meters (850 nm) and meet OM3 specifications.
- C. Description: Fiber Optic Cable shall be UL listed for indoor/outdoor applications type OFNP; 50/125-micron multimode fibers for 10 Gigabit Ethernet transmission, each with a color-coded PVC buffer with DryGel water blocking. Provide strand counts between closets as indicated on drawings.
- D. Provide plenum rated steel or aluminum armored cable.

2.9 FIBER OPTIC CABLE TERMINATIONS

- A. Manufacturers - ISO 9001 Certified
  - 1. Corning Cable Systems
  - 2. Hubbell
  - 3. CommScope
  - 4. Leviton
  - 5. 3M
- B. Use type ceramic LC fiber optic connectors (**verify connector type with Owner prior to ordering**). Coordinate connectors with the duplex connectors in the patch panels and possibly the ethernet switches. Connectors shall be ceramic.
- C. Terminate all of the fibers of the fiber optic cables. Provide all termination accessories for a complete fiber optic distribution system.

2.10 PATCH CORD ASSEMBLIES

- A. Copper patch cord assemblies must meet the requirements of the Category cable specified performance criteria, and shall be factory-manufactured in 3-foot, 5-foot, 7-foot, 10-foot, 15-foot, and 25-foot lengths. The cables shall be manufactured by the selected connectivity manufacturer.
  - 1. Prior to ordering, the Contractor shall verify, with the Owner, patch cord lengths for each system.
- B. Provide two (2) copper patch cords for each **data outlet** in the following quantities: Provide 10% in 3-foot (yellow color) lengths, provide 20% in 5-foot (purple color) lengths, provide 25% in 7-foot (red color) lengths, provide 20% in 10-foot (yellow color), provide 20% in 15-foot (white color) lengths, and 5% in 25-foot (gray color) lengths.
- C. Provide two (2) patch cords for each **wireless access point outlet**, provide 50% in 6-foot lengths and 50% in 25-foot lengths with colors matching the cable jacket color. The 6-foot lengths shall be located at the closet, while the 25-foot lengths shall be located at the jack above the ceiling. The contractor shall pre-install all 25-foot cables and coil at the jack.

2.11 PATCH PANELS - Copper Cables

- A. Manufacturer - ISO 9001 Certified - shall match the manufacturer of the data outlets.
- B. Provide patch panels separated by system (do not mix different systems on the same patch panel), unless directed otherwise by the Owner.
- C. All patch panels shall be of the channel manufacturer or partner. The data station cables shall be terminated on modular jack patch panels with circuit board construction in all closet locations. The patch panels shall have rolled upper and lower edges for rigidity, metal covering over PCB for protection, and shall provide front and rear side labeling visible after the cables and cords are installed. The 8-position modular jack patch panels shall be rack mounted. Provide 48 port, 2-rack unit high (single rack unit high density shall not be acceptable), pre-loaded panels (T568B or T568A wired (per Owner direction), TIA/EIA-568) in quantities required for the number of data outlets. Provide a minimum of 25% spare ports in patch panels. **Verify patch panels with owner prior to ordering.**

1. **Only 48 port patch panels shall be provided as part of this project. 24 port, or fewer patch panels shall not be acceptable.**

D. All patch panels shall be of the channel manufacturer or partner. Keystone style, unloaded patch panels shall be provided at the MDF/IDF locations. Provide 48 port panels, 2-rack unit high (single rack unit high density shall not be acceptable) in quantities required for the number of data outlets. Load panels with keystone style jacks matching the station hardware. Provide a minimum of 25% spare ports in each closet (including spare keystone jacks). Existing unloaded patch panels may not be used. Provide jacks matching the wire color. **Verify patch panels type with owner prior to ordering.**

1. **Only 48 port patch panels shall be provided as part of this project. 24 port, or fewer patch panels shall not be acceptable.**

#### 2.12 PATCH PANELS - Fiber Optic Cables

A. Manufacturer - ISO 9001 Certified - Corning Cable Systems or equivalent

B. Provide the following at the data closets and racks. Manufacturer shall match connections to maintain system warranties.

1. Closet connector housings shall be similar to Corning Cable Systems Part CCH-xxU for rack mount and WCH-xxU for wall mount. Provide sufficient space to allow for a minimum additional two (2) empty panel spots. Provide blank covers for unused openings.
2. Connector panels similar to Corning Cable Systems Part CCH-CP12-xx shall be provided to match the fiber being specified (single-mode, multi-mode (class as indicated)). Provide panels with 6 duplex (12 total) jacks, and connect 3 duplex jacks in each panel (if 12 fibers are specified, provide two (2) panels).
3. Fiber connections shall match those as specified in the terminations, unless noted otherwise.

C. Provide blue color connectors for single-mode fibers and **beige (1GB fiber) aqua (10GB fiber)** color connectors for multi-mode fibers.

D. The contractor may use pig-tail type connector housings and fusion splice strands in lieu of the specified.

#### 2.13 EQUIPMENT RACKS

A. Floor-mounted Cabinets: Unless specifically addressed below, provide aluminum enclosed equipment cabinets with metal perforated doors in locations indicated on the drawings and as required to terminate all outlets indicated on the drawings. Cabinets shall be standard 19" mounting width, full height (84") with 36" maximum mounting depth and leveling feet. Doors and side panels shall be lockable and removable. Cabinets shall be Chatsworth #T2050-752 with #12465-707 vertical cabling sections and #12724-701 fan kit (plug fan into power strip), or equivalent by Great Lakes, B-Line, Middle Atlantic Products, Hubbell or Rittal. Cable managers shall be provided on each side of rack. Provide one (1) perforated stationary shelf, approx. 24"D per rack for future equipment, and all necessary rails and mounting hardware. Bolt rack to floor and provide wall bracket at top to fasten rack securely to wall.

B. Cable Manager: The cable manager shall be no more than 2RU high, fit a standard 19" rack, provided with a front door, approx. 8.2" deep and be provided with edge-protected oval cable

pass-through ports at the rear of the cable manager. Provide Chatsworth #35441-702. Cable managers shall be of the same manufacturer as equipment rack.

- C. Provide cable managers and patch panels in the following sequence from the top of the rack: One (1) cable management, two (2) 48-port patch panels, one (1) cable management, two (2) 48-port patch panels, etc, until completed or rack is full. Ethernet switches will be furnished and installed by the Owner below the patch panels or in the adjacent rack. Furnish ten (10) additional cable managers (2 RU) for installation by the Owner with the Ethernet switches. Coordinate the exact rack layout with the Owner in field.
- D. In the back of all floor mounted data racks/cabinets, provide a vertical rack mounted power strip with 24, 20A outlets, 2 20A circuit breakers, current monitor (ckt. 1, 2 and total) and 10-foot power cord with a 30A, 120V twist-lock plug, Geist Cat. No. XPBM240-103D20TL5 or equivalent by Hubbell, Wiremold or Server Technology. Provide mounting brackets as required.
- E. Rack Grounding: Provide grounding kit for all racks. Rack shall be grounded using stranded #6 AWG insulated copper conductor. Provide all required bonding material and hardware and bond to building ground system. 4/0 cable, unless otherwise noted, shall be used for the grounding conductors from the MDF to the IDF and from the electric service grounding to the MDF.

#### 2.14 VOICE OUTLETS

- A. Voice Outlet - Same as data outlets.
- B. Wall Mount Type - Hubbell Catalog No. P630SR1GJ8 or equivalent with one (1) Cat 6 RJ-45 modular jack, 8-conductor, stainless steel wall plate, and mounting screws. Verify jack compatibility with wall phone to ensure proper installation of phone.

#### 2.15 RISER CABLES - Voice Backbone

- A. Manufacturers - ISO 9001 Certified
  - 1. Mohawk/CDT Part #M58142 (25PR)
  - 2. Belden
  - 3. Essex
  - 4. Commscope
  - 5. Berk-Tek
  - 6. Avaya
- B. Description: Power Sum Backbone Cable, 25 pair, unshielded twisted pair cable, category 5e, verified to 100MHz, CMP listed, for use with IEEE Std. 802.3 network, and TIA/EIA-568-c.2 compliant using 4 pairs, 24 AWG solid copper conductors all FEP insulated, colored plenum rated jacket.
- C. Terminate riser cable in data closet on voice backbone patch panels.
- D. Where cables enter a building from the exterior, provide solid state lightning protection in building at termination location.

#### 2.16 PLYWOOD BACKBOARD

- A. Backboard: 3/4-inch interior, fire-rated, grade 'B' plywood furnished and installed by the electrical contractor. Provide a light-colored, fire-retardant paint to the backboard.

2.17 LABELING REQUIREMENTS

- A. Refer to Division 26 "Electrical Identification" for additional labeling requirements.
- B. Cable Ties:
  - 1. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
    - a. Minimum Width: 3/16 inch.
    - b. Tensile Strength at 73 deg F according to ASTM D638: 7000 psi.
    - c. UL 94 Flame Rating: 94V-0.
    - d. Temperature Range: Minus 50 to plus 284 deg F.
    - e. Color: Black.
- C. Provide manufacturer jack labeling inserts, etc. at patch panels and jacks.
- D. All data devices, installed by the contractor, including, but not limited to CCTV cameras, WAPs, IP speakers, etc., shall be provided with labels match jack label. Verify location of label with owner prior to adhering.
- E. All labeling must be typewritten or engraved.

2.18 NETWORK ELECTRONICS

- A. Network Electronics will be furnished and installed by Owner, unless noted otherwise.
- B. The Owner shall furnish wireless access points to the Contractor. The Contractor shall install the access points in the rooms where shown on plans or otherwise directed by the Owner. The Contractor shall assume all of the wireless access jacks will receive an access point. At the wireless access jacks that do not receive an access point, the Contractor shall coil the 25-foot patch cable above the ceiling at the jack for future use.
  - 1. Where jacks are installed above ceilings, labels shall be provided on T-bar of ceiling to identify location of jack. Label shall match jack label. Ends of patch cables shall also be labeled with same information.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall provide minimum 1" conduit sleeves or as indicated on the drawings above ceilings between corridors and areas where data outlets are located, and elsewhere where required to install data cabling, avoiding penetration of fire rated walls.
- B. Any penetration through fire rated walls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant. Use fire stop material as specified in Division 26 "Common Requirements – Electrical." Contractor shall also seal all floor, ceiling, and wall penetrations in fire or smoke barriers and in the wiring closets.
- C. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.

- D. Recommended Products:
1. Twisted-pair cable: Dyna-Blue, American Polywater
  2. Optical fiber cable: Optic-Lube, Ideal
- E. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over tightened bindings, loosely twisted and over twisted pairs at terminals, and sheath removed too far (over 2").
- F. All low voltage cabling, run in walls, shall be installed in minimum 1" rigid conduit. Back boxes must be full 3.5" deep backboxes (low voltage rings shall not be acceptable). Refer to applicable Division 26 sections for additional requirements.
- G. J-Hooks:
1. J-hooks shall be galvanized, comply with TIA-569-D, and be listed for the use.
  2. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
  3. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
  4. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
  5. Space hooks no more than 5 feet (1.5 m) o.c.
  6. Provide a hook at each change in direction.

### 3.2 LABELS

- A. The labeling plan shall be developed by the Contractor and approved by Owner/Engineer. The Contractor will label all outlets following the detailed shop drawing design, using permanent/legible typed or machine engraved labels. Terminals in the data closets shall be labeled by the Contractor using designation strips as applicable to terminal hardware. All copper/fiber terminal for riser cables in the data closets shall correspond to terminal numbering in the MDF. All voice outlets will be installed together on a patch panel at the top of the racks.
- B. The labels on IDF station terminals shall be labeled in accordance with TIA/EIA standards. Outlets shall be labeled to match the labels on the corresponding terminal position. The room number component shall reflect the final room numbering system utilized for door labels or room numbers when the Owner occupies the building. **Should the actual final room numbers not be used, the contract will be required to re-label all jacks and wiring, and retest the entire system.**
- C. A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans. Plans shall be the size of the construction documents.
1. An additional copy of the floor plans, laminated, shall be posted in each data room. Plans shall be the size of the construction documents.
- D. All labels shall correspond to as-built and to final test reports.
- E. The cables themselves shall also be labeled at each end of the cable matching the labeling method.

- F. Where jacks are installed above the accessible ceiling, labels shall be applied to the T-Bar. The label shall match the jack label.
- G. All devices, installed by the contractor, including, but not limited to wireless access points, IP speakers, etc. shall receive a label with the jack information. Verify with owner, location of label (exposed, or behind device).
- H. Racks and cabinets shall be labeled with closet designation with self-adhesive labels.
- I. Where jacks are installed above ceilings, labels shall be provided on T-bar of ceiling to identify location of jack. Label shall match jack label.

### 3.3 WIRING INSTALLATION

- A. All copper horizontal data cables and Fiber Optic cables shall be installed by individuals trained and certified in data cable system installation.
- B. All Category (4) pair UTP cable must be handled with care during installation so as not to change performance specifications. The Contractor shall not over tighten fasteners or over bend the Category UTP cable. Creased or kinked cables will not be accepted and will be replaced. Tie wraps are NOT permitted to organize or bundle cables. Contractor must use velcro wraps to bundle cables. Velcro wraps shall be UL rated for installation above plenum ceilings.
- C. **Should the Engineer/Owner find tie wraps on cables, the contractor shall be responsible to remove the tie wraps and all cables housed within the tie wraps will be assumed to be damaged and will require replacement.**
- D. All wiring and associated hardware shall be placed so as to make efficient use of available space in coordination with other uses. All wiring and associated hardware shall be placed so as to not impair the use or capacity of other building systems, equipment, or hardware placed by others (or existing).
- E. All cabling installed in ceiling areas must be supported or installed in cable tray. Cable tray will be provided by this Contractor as indicated on the drawings. Where cabling is installed in ceiling areas or other non-exposed areas without cable tray, supports shall be placed by the Contractor at random intervals no greater than 60 inches and preferably on 48-inch centers. Cable sag between supports shall not exceed 12 inches. Attaching wire to pipes or other mechanical items is not permitted. At all runs of twenty or more cables, provide J-hooks at 60-inch (maximum) centers to hang cable.
  - 1. Where cables are installed in exposed areas (exposed structure, etc.) they shall be installed in conduit. Conduit shall be sized for 40% fill, but shall be no smaller than 1". **Should any cable be installed exposed, the cable will be required to be replaced and retested at no additional cost to the Owner.**
- F. All low voltage cable shall be routed to avoid light fixtures (18 inches minimum spacing), sources of heat (12 inches minimum spacing) power feeder conduits (12 inches minimum spacing). Low voltage cabling must be spaced a minimum 120 inches (10 feet) from bus duct.
- G. Use Brandy type labels on cable ends in the data racks and in the outlet boxes.
- H. An additional minimum ten (10) foot of slack shall be provided at both ends of all cables. The slack shall be wrapped in Velcro straps supported from the steel, walls or cable tray. The cables shall not touch the ceiling.



- I. **Exterior CCTV/Camera cables shall be installed on the exterior of the building. The contractor shall be responsible to extend the cabling to the exterior of the building part of his work ready for the owner to install the exterior camera.**

### 3.4 FIBER OPTIC CABLE INSTALLATION

- A. Conduit and cable shall be installed in accordance with manufacturer's instructions and industry standards. Care shall be taken to avoid kinking the cable or applying excessive tension during the installation process.
- B. Armored type cables shall be installed in cable tray or on j-hooks.
- C. Non-armored type shall be installed in minimum 1" plenum rated innerduct, attached to cable tray or in j-hooks.

### 3.5 STATION HARDWARE

- A. Eight (8) position modular jack Pin Assignments:
  - 1. Pin connections for data station 8 position modular jacks and patch panels shall match TIA/EIA-568-c.2.
  - 2. Pin connections at data jacks and panels shall be TIA 568A or 568B as directed by the Owner.

### 3.6 BACKBOARD CABLING/EQUIPMENT RACK CONFIGURATION

- A. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance purposes such as access boxes, ventilation mixing boxes, network equipment mounting, access hatches to air filters, switches or electrical panels, and lighting fixtures. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings. Provide a minimum of 36 inches for a service loop to the patch panel.
- B. Cable shall be routed as close as possible to the ceiling, floor, or corners to ensure that adequate wall or backboard space is available for current and future equipment and for cable terminations. Cables shall not be tie-wrapped to existing electrical conduit or other equipment. Minimum bend radius shall be observed.
- C. Lay cables via the shortest route directly to the nearest edge of the backboard from the mounted equipment or block. Lace or tie-clamp all similarly routed cables together, and attach by means of clamps screwed to the outside edge(s) of the backboard vertically and/or horizontally, then route via "square" corners over a path that will offer minimum obstruction to future installations of equipment, backboards, or other cables.
- D. Do not over tighten cable ties or binding on data station cable. Observe data cabling bend radius, and IEEE and NEC conduit fill ratios (40%).
- E. Use cable tray or runway to support cables from walls to rack or crossing the data closets.

**3.7 CABLE TESTING**

- A. This contractor shall submit to the Owner/Engineer the proposed testing procedure and testing report form. The test report shall include the test equipment operator's name, date, time, test equipment manufacturer's name, model number, and software version.
- B. The Owner/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- C. Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the industry standard test procedures, test result forms, and timetable for fiber optic and all copper plant wiring.
- D. Acceptance of the sample test procedures discussed below is predicated on the Contractor's use of the recommended products (including but not limited to twisted pair cable, patch panels, and outlet devices specified in the Products paragraph) and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
- E. Test Criteria: The system shall be tested to Category Level III compliance matching specified cable. The test path shall include workstation jacks, station cables, patch panels, and adapter cables. Test shall be performed with a MicroTest Omniscanner, Fluke, or equivalent product. Tester must have minimum dynamic range of 87dB and scan to at least 400MHz.
- F. The Contractor shall test:
  - 1. All station drop cable pairs from termination patch panels to outlet device 8 position modular jacks.
  - 2. All backbone cabling.
- G. Each wire/pair shall be tested at both ends for the following up to 400MHz in accordance to Category cable specified:
  - 1. Termination order
  - 2. Polarity (pair reversals)
  - 3. Continuity
  - 4. Shorts
  - 5. Grounds
  - 6. Power-Sum NEXT (near end cross talk) from both directions
  - 7. Cable length (record all length)
  - 8. Attenuation
  - 9. Power-Sum Return Loss
  - 10. Power-Sum ELFEXT from both directions
  - 11. Impedance
- H. When errors are found, the source of each error shall be determined, corrected, and the cable re-tested. All defective components shall be replaced and retested. Defective components not corrected shall be reported to the Owner/Engineer with explanations of the corrective actions attempted.
- I. Test records shall be maintained using the test results forms outlined below. The form shall record closet number, riser pair number or outlet ID, outcome of test, indication of errors found (e.g., a, b, c, d, or e) cable length, re-test results after problem resolution and signature of the technician completing the tests.

- J. Test results for each (4) pair UTP cable must be submitted with identification to match labels on all patch panel ports and 8 position modular jacks, and identification to match as-builts associated with that cable.
- K. Owner will observe and verify the accuracy of test results submitted, and reserves the right to randomly check any connection prior to acceptance.
- L. The results of the work station cable tests shall be provided in the form of print-outs from the test equipment and USB disk with PDFs.

### 3.8 FIBER OPTIC TESTING SPECIFICATIONS

- A. Each fiber strand shall undergo bi-directional testing for signal attenuation, and connector and splice losses. In addition to the attenuation testing, provide OTDR signature trace testing and documentation by computer file or print out for each fiber strand.
- B. Test Equipment: Light Source and Level III Power Meter manufactured by Microtest (Certifiber), Wavetek, or Fluke. Utilize additional modules and equipment to provide specified OTDR signature trace in addition to the signal attenuation and loss tests.
- C. Test Criteria: Connector loss shall not exceed 0.75 dB per termination.
- D. All testing shall be performed by trained personnel.
- E. All installed fiber optic cable EIA 455-171 Method D procedures will be adhered to. (Bi-directional)
- F. For multi-mode fiber, the maximum attenuation for the fiber optic cable shall not exceed 3.5 dB/km tested at 850nm and 1.5 dB/km tested at 1300 nm.
- G. For single-mode fiber, the maximum attenuation for the fiber optic cable shall not exceed 1dB per kilometer tested at 1310 nm and 1550 nm.
- H. The contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer's specifications.
- I. All single-mode fibers shall be tested for continuity and attenuation in both directions at 1310nm with a fiber optic light source and power meter. Before beginning test, the contractor shall submit to the Engineer/Owner a design fiber optic loss budget for the segment to be tested, based upon the length of the fiber optic cable installed. When tested at both windows in both directions, the measured attenuation of each fiber optic cable segment shall be less than or equal to the design attenuation of the segment being tested. Until this condition has been met, the installation shall not be considered complete and will not be accepted.
- J. While the specified OTDR signature trace is not required for manufacturer warranty acceptance, it will be used to ensure the fiber did not sustain any kinks or hits during installation that might allow for an approved acceptance test, but will create problems for ancillary systems other than data transfer. Should an anomaly be present in the testing in any of the fibers, the cable will be required to be removed and replaced with a new cable. Fusion splices in new cables without prior written approval from the Engineer/Owner shall not be acceptable.

### 3.9 DOCUMENTATION

- A. Contractor shall provide documentation to include test results and as-built drawings.

- B. Fiber Test Results: The results of the fiber testing shall be recorded on a form entitled "Fiber Attenuation and OTDR Test Results." Results shall be in digital format and printed hard copies. Electronic copies are required with date/time stamping, circuit identification, and Pass/Fail listing.
- C. As-built drawing showing data outlets (with labels) of area served by each data closet shall be laminated and attached a wall in each respective data closet. Coordinate location in field with Engineer and Owner.

3.10 ACCEPTANCE

- A. Acceptance of the Data Network System shall be based on the results of testing, functionality, and the receipt of documentation. With regard to testing, all fiber segments and all copper cables must meet the criteria established above. With regard to functionality, Contractor must demonstrate to Owner that 1000BaseT data signals can be successfully transmitted, bi-directionally, from the MDF to and from some number of individual data outlets by using OmniScanner testing IEEE 802.3ab for 1000BaseT. The number of outlet locations to be tested shall be determined by Owner/Engineer. With regard to documentation, all required documentation shall be submitted to Owner/Engineer.
- B. The backbone cable shall also be tested for functionality to the Owner for 10 GbE.

END OF SECTION 271500



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SECTION 275123 – INTERCOMMUNICATIONS/CLOCK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall be responsible to furnish, install and extend as specified/as required the **Existing Telecor II Intercommunications and Clock systems** into the renovated spaces in the **main building and to the “New Welding Building”**. Work shall include all new equipment, devices, wiring (low voltage, power and fiber optic cabling between buildings). System shall be started up tested and signed off by Berkshire systems prior to school district taking over the system. Warranty shall also be provided as described in this section.
- B. **Contractor shall be required to provide 120volt unswitched power wiring to all clocks. Contractor shall be required to provide 20/2 twisted shield pair for clock correction looped from clock to clock.**
- C. Provide interconnections as listed in part 2.
- D. Provide product demonstration and training as listed in part 3.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature and installation instructions with system wiring diagrams. Provide a complete listing of all major components required for a complete and fully operational system.
- B. Maintenance Data: Include data in the maintenance Manual specified in Non-Technical Specifications and Division 26 "Basic Electrical Requirements."
- C. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under use conditions. Submit three complete sets of operating instructions including wiring and circuit diagrams.
- D. Inventory: Supply with the manuals an inventory of the equipment provided.
- E. When preparing submittals and any required final programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers.
- F. Submit un-executed contract for full specified warranty, indicating parts and labor to be covered to be reviewed prior to installation. At substantial completion, warranty must be fully executed between installing vendor and owner.

1.3 QUALIFICATIONS

- A. Supplier: Berkshire Systems Group.

1.4 REGULATORY REQUIREMENTS

- A. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction, and that portion of the NEC which pertains to installation and construction of specified products.
- B. FCC Compliance: Comply with U.S. Federal Communication Class B standard for allowable radiation from equipment and wiring.
- C. Institute for Electrical and Electronic Engineers (IEEE): Comply with all applicable standards for audio, video, and data networks.
- D. Americans with Disabilities Act (ADA): Accessibility Guidelines for buildings and Facilities.

1.5 MAINTENANCE SERVICE WARRANTY

- A. Special Project Warranty: Submit a written warranty, executed by the contractor, installer, and the manufacturer, agreeing to repair or replace equipment which fails in material or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the owner may have against the contractor under the contract documents.
- B. Warranty of Conformance with Specifications: The contractor shall warrant that all specified functions shall be provided even if functional omission is not discovered until the end of the warranty period. This shall warranty full function of the system even if the owner does not fully utilize the capabilities of the system initially.
- C. Full parts and labor warranty period shall be five (5) years after the Date of substantial completion and useful implementation of the system. Warranty shall include on-site service labor and loaner parts to keep the system fully operational during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Equipment manufactured by **Telecor** shall be considered as meeting these specifications.
- B. Additions to the existing Telecor 2 on site Intercommunications/Clock System:

1.	<u>Manufacturer</u>	<u>Model</u>	<u>Description</u>
	AtlasIED	HD72W	Ceiling Speaker Assembly: (speaker, transformer, grille,)
	AtlasIED	CS95-8	Ceiling Speaker Back Box
	AtlasIED	81-8R	Ceiling Speaker Tile Bridge Support
	AtlasIED	APX40TN	Surface Horn Speaker
	Lowell	DSQ-805-72	Surface Mount Classroom-Office Speaker A
	Lowell	LWR-1019	10U 19D Wall Mount Equipment Cabinet
	Telecor	2420-S-120	Surface Mount 2.5" Digital Clock Assembly
	Telecor	2430-S-120	Surface Mount 4.0" Digital Clock Assembly
	Telecor	2420-F-120	Flush Mount 2.5" Digital Clock Assembly
	Telecor	2430-F-120	Flush Mount 4.0" Digital Clock Assembly
	Telecor	TBU-IP-MI-MA	IP Termination Unit - 25 Stations
	Telecor	AC-15	Power Bar
	Telecor	CHAP-25/2-P	12' Cable Harness (25 pairs c/w Amphenol)
	Telecor	TM-2X25	Terminal Block (Supports 2 CHAP-25/2-P's)

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Telecor	CPU-4	Central Processor Unit
Telecor	IPI-MC	IP Interface Module
Telecor	RCD-7-XL	Remote Clock Driver
FiberPlex	TKIT-TG-50G	10/100/1000 BaseT Fiber Link Kit
Trendnet	TPE-TG50G	PoE Network Switch
Lowell	LUH-BOX	Exterior Flush Wall Speaker Back Box
Lowell	LUH-15TX	Exterior Speaker
Lowell	LUH-VRG	Vandal Proof Guard

## 2.2 INTERCONNECTIONS

### A. Fire Alarm System:

1. Provide relays and sensors as required at the fire alarm system so that the PA system will mute during an alarm initiated from the fire alarm system. Provide an override switch at the main mic and at the rack so that this interface can be overridden in the event an all page is required to inform the occupants.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. All data wiring must meet Division 27 "Communications Cabling," and be fully tested, supported and warranted as part of the data system.
- B. Comply with installation instructions provided by system manufacturer. Provide type of cables as required.
- C. All wiring shall be plenum rated where required by code.
- D. Install system to comply with drawings and final shop drawings in compliance with manufacturer's printed instructions.
- E. Cable identification: shall be provided on both ends of each cable and termination with the owner's room number and the wiring block or device to which it is connected. Tags shall be permanent and neat.
- F. Furnish and install necessary conduit, raceways, pull boxes, outlet boxes and wire to provide a complete system or systems as herein specified. All wiring shall be tested for continuity and freedom of all grounds and short circuits.
- G. All low voltage cables must be continuous runs between termination points.
- H. Intercommunications system cable shall not share conduit with any other system.
- I. **The Contractor shall be responsible to provide a 2-Strand Multi-Mode (indoor/outdoor) rated Fiber Optic Cable from existing main building Intercommunications rack in mezzanine (near Bricklaying) to New Welding Building Cabinet (Data Closet 108) via existing main building and new welding building. Provide all terminations.**



- J. The Contractor shall use the types of wire recommended by the Sound Equipment Manufacturer. The Contractor in no case shall use the type of wire which he merely assumes to be the best. This recommendation shall be from the equipment manufacturer.
- K. The central control console shall be provided with a 10AWG ground wire to earth ground. Conduit ground shall not be acceptable for this purpose.

### 3.2 DEMONSTRATION

- A. Programming: Review all system programming with the owner's representative and the engineer and obtain written approval before system is put on line. Telephone service interface shall be coordinated with the owner but paid for and performed by this contractor.
- B. Subsequent to hookups of equipment, test the entire system and demonstrate proper functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.
- C. Documentation: Bind the test results and cable identification in a cable record book indexed for easy reference during future maintenance operations. Turn book over to the owner's authorized representative upon completion of commissioning.
- D. All remote sound reinforcement systems shall be tuned by a qualified technician. The technician shall provide printed documentation of all system settings and raw and final system equalization settings as determined by real time analyzer from a minimum of 3 averaged locations in each space. Provide reports in close-out documentation.

### 3.3 TRAINING

- A. Upon completion of installation, arrange in service training of the system operation for personnel designated by the owner. Provide a minimum of two, four (4) hour training sessions. Notify in writing through the Electrical Contractor, the Architect, and the Owner of the time and date the first demonstration will take place. Conduct a walking tour of the system.
- B. Provide training on how to program the system using the master telephone and through the computer interface to the system.
- C. Six (6) to twelve (12) months from substantial completion, provide an additional minimum four (4) hour on-site training session with the owner to review the system with owner designated personnel. During this training, provide additional programming services as required/requested.

END OF SECTION 275123

**SECTION 281300 – ACCESS CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 SYSTEM OVERVIEW**

- A. The Existing buildings POE Access Control System shall be expanded to the renovated area and new Welding Building.
  - 1. The system shall seamlessly integrate into the owner's existing access control system.
- B. The Access Control system shall meet the following requirements:
  - 1. The system shall be provided with proximity card readers, system controls, alarm displays, etc.
  - 2. The system shall be provided to provide access control at all access control doors and monitor and annunciate all access points to the building.
- C. Audio/visual door intercommunications (IC - station outside main entrance to Welding Building and existing entrance beside Diesel Mech.) system shall be provided as indicated on the drawings. The door intercommunications shall be interconnected with the Access Control to allow activation of the access control door hardware upon valid identification.

**1.2 EQUIPMENT SUPPLIER**

- A. The equipment shall be supplied by the Owners Access control vendor unless noted otherwise.

**1.3 WARRANTY**

- A. All equipment and labor provided under this specification section shall be warranted for a period of one (1) year after project completion.

**1.4 SCOPE OF WORK**

- A. Door intercommunications shall be provided as manufactured by A-Phone. The owner shall provide (1) flush and (1) surface mounted station (with 30 degree mounting bracket) and turn over to Electrical Contractor to install. The E.C. shall provide ¾" conduit to above ceiling plenum. E.C. shall provide Cat 6 from A-Phone to Data closet.
- B. The Door Hardware Manufacturer shall provide the door power supply. Power wiring to the power supply shall be provided by the electrical contractor
- C. All exterior doors shall be provided with door contacts. Door manufacturer shall provide door contacts part of his work. Electrical Contractor shall provide door contacts for Garage Doors. The E.C. shall provide all wiring required for door contacts.
- D. Electric Door Strike shall be provided by the door hardware manufacturer. E.C. shall provide all wiring of door strike.
- E. The Electrical Contractor shall provide all raceways from device to above ceiling where required.

- F. Door reader shall be provided by the owner and turned over to the E.C. to install. The E.C. shall provide a Cat 6 cable from reader location to Data closet.

**PART 2 - EXECUTION**

**2.1 INSTALLATION**

- A. Furnish labor, materials and methods required to provide the complete Access Control System work, in first class condition, as indicated in the Drawings and specified herein, including all devices, conduit, wiring, and connection to normal/emergency 120 VAC sources.
- B. Verify all dimensions and conditions at job site.
- C. Supply, install, make operative, and test, the system and its components in accordance with applicable codes, local authorities having jurisdiction and manufacturers' recommended practices.
- D. Produce and update, and submit to the owner or his designated representatives, in accordance
- E. All cabling shall meet all local, state and National Codes. All 24VAC power cabling shall be a minimum of 14 gauge and sized based on the current draw and distance of the device. Components mounted above ceilings shall be approved for use in plenum spaces.
- F. Coordinate the system programming with the owner. The system shall be fully programmed. Provide initial programming after an initial meeting with the owner. Program tweaking may be performed during one of the training sessions.
- G. Provide solid state lightning protection for all low voltage copper cables routed to exterior cameras per NEC.
- H. All 120 VAC power required shall be from a normal/emergency source. Where the building is furnished with an uninterruptable power supply, provide power from a UPS panel.
- I. Install door intercom stations at indicated locations. Provide all required data wiring and door wiring per manufacturer requirements.

END OF SECTION 281300

**SECTION 283100 - SECURITY ALARM SYSTEM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Security system expansion shall be included as part of the project base bid.
- B. The system shall include, but not be limited to, the following additions to the existing NAPCO security system:
  - 1. Alpha/Numeric Keypads
  - 2. Motion Detectors
  - 3. Garage Door Contact
  - 4. Flush Exterior Door Contacts
  - 6. Overhead door Contacts
  - 7. Conduit, Wire, Outlet Boxes, Complete Installation

**1.2 SYSTEM DESCRIPTION**

- A. All security alarm monitoring devices shall report individually to the security control unit and display abnormal conditions on the alpha/numeric keypads. Each device shall be programmed to display a 20-character message describing location on the keypads. Garage and entrance doors shall report as a single point or zone to the system.
- B. The keypads shall be the human interface to the system for arming and disarming by zone, displaying system status, bypassing individual devices, programming the system and other interactive operations. The keypad operations shall be password protected.
- C. Before arming a zone, the operator may check system status to verify that the zone is ready for arming. If an abnormal condition exists such as a motion detector in alarm, the keypad shall indicate the specific location so the operator can correct the condition.
- D. When armed and an alarm occurs, the following operation shall occur:
  - 1. The device in alarm shall be displayed on the keypad.
  - 2. An output shall be generated to the Building Security siren located outside. The security alarm tone shall be a complete separate tone than the tone which is being used for other Alarm signaling.
  - 3. The built-in digital communicator shall report the alarm condition to the Central Station Service for dispatching Security or Police as directed by the Owner.
  - 4. The audible alarm tone shall be automatically silenced after a preprogrammed time period. If an alarm condition occurs on another device, the alarm signal shall resound and the alarm reported to the Central Station.

**1.3 SUBMITTALS**

- A. Shop drawings: Provide system wiring diagram showing each device and wiring connection required.

- B. Product Data: Provide electrical characteristics and connection requirements.
- C. Test Reports: Indicate satisfactory completion of required tests and inspections.
- D. Manufacturer's installation instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.4 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Provide operating instructions.
- B. Maintenance Data: Provide Maintenance and repair procedures.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of the Project.
- B. Installer: Company specializing in installing the products specified in this section with minimum five years documented experience.

1.7 WARRANTY

- A. The entire system shall be under warranty for a period of one year from period of first satisfactory use by the Owner. The warranty shall include the repair or replacement of any defective material, installation, labor and travel to the project site, providing the condition was not a result of vandalism or misuse.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. All control equipment, communicator, door and window contacts, and motion detectors shall be U.L. Listed for their intended purpose.
- B. Control/Communicator - The Existing Control/communicator is a Napco Model 3000 with the following features:
  - 1. 36 Programmable Zones - Expandable to 96 Zones
  - 2. 8 Arm/Disarm Partitions - Provides 8 completely independent protection areas that can be individually armed and disarmed. Each building shall be an independent partition.
  - 3. 96 User Codes - Individually codes area assignable to individual protection areas or "global".
  - 4. Opening and Closing Reports - capable of reporting on what code was used to arm/disarm a protection area.
  - 5. Digital Communicator - Built into control unit to report alarms to a central station

service by zone, openings and closings if desired. Only one central station fee will be charged to cover all protection areas.

- C. Alpha/Numeric Keypad - English Language LCD Displays that provides an indication of alarms, troubles, system conditions, armed/disarmed mode, system management functions, silence and reset functions. Napco Model RP3000LCD. **Keypad shall be recessed in wall of welding building.**
  - 1. Keypad Protector STI Model 6500 series keypad protector with lockable cover, tamperproof screws, 12-volt heater, and required backplate.
- D. Motion Detectors - Ceiling Mount Passive Infrared motion detectors that provides 360 degree protection up to sixty feet in diameter coverage. Includes screw-locking cover for vandal protection. Detection Systems, Inc. Model DS938.
- E. Flush Door Contacts - Flush door contacts shall be suitable for exterior steel doors and frames. The contact assembly shall be hermetically sealed to protect from high moisture conditions. NASCOM N1178B/ST, 1" wide gap or equal. Refer to Architectural Door Hardware drawings to verify contacts will be provided with door.
- F. Overhead Door Contacts – Overhead door contacts shall be suitable for exterior overhead steel doors. The contact assembly shall be hermetically sealed to protect from high moisture conditions. NASCOM N205AU/ST, 1" wide gap or equal.
- G. Surge Suppression- Provide surge suppression on any security system wiring leaving or entering building. Provide # 10 ground wire to local earth ground. Provide DITEK Model DTK-4LVLPV.

## 2.2 ACCEPTABLE MANUFACTURERS

- A. Napco
- B. Ditek
- C. Acceptable Manufacturer/Supplier - All equipment shall be manufactured as indicated for each system. A qualified Authorized Distributor of these products is as follows:
  - 1. Berkshire Systems Group, Inc. 1-610-775-1200, contact person Luke Hahn.

## PART 3 - INSTALLATION

### 3.1 INSTALLATION AND WIRING

- A. All equipment in this section shall be installed in accordance with the National Electric Code for alarm and communications systems. All ceiling mounted devices shall be installed with electrical outlet boxes which shall be supported by approved hangers and brackets. Devices shall not be installed in a manner that is supported by only the ceiling tile.
- B. Contractor shall be responsible for **all wiring 120volt, or low voltage for the system.**

- C. Contractor shall be responsible for all wiring run between main building and Welding Building required for a complete and operational system.

**3.2 PROGRAMMING AND TEST**

- A. After completion of the installation of the system and before the system is turned over to the Owner, the system shall be completely tested by the Equipment Supplier for proper operation. After satisfactory operation without false alarms for a period of at least 2 weeks, the Central Station Service shall be programmed for automatic reporting for Police Dispatch upon alarm.

**3.3 DEMONSTRATION AND TRAINING**

- A. The Equipment Supplier shall arrange demonstration and training of the system operation with representatives of the Building Owner. Multiple visits shall be provided to train the desired personnel that will operate the system.
- B. Include the services of a technician to supervise installation, adjustments, final connections, system testing, and training Owner's personnel.

END OF SECTION 283100

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SECTION 284621 - FIRE ALARM AND DETECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. It is the intent of these specifications, drawings, and schedules to describe the minimum requirements to **extend the existing main buildings fire alarm system to the new welding building. Furnish and install new fire alarm system devices, equipment, wiring (low and 120volt) in new welding building and main building renovation areas. Provide wiring between buildings (1-18/2, 1-14/2 or as otherwise directed by FA vender)** The system shall include the following:
1. Addressable Monitoring and Control.
  2. Manual Operator Switches and Annunciation.
  3. Manual Stations.
  4. Addressable Smoke Detectors with Application Specific Detection.
  5. Addressable Duct Smoke Detectors with Application Specific Detection.
  6. Addressable Heat Detection.
  7. Addressable Monitoring and Control Modes for:
    - a. Air Handling Unit Control.
    - b. Smoke Damper Control.
    - c. Sprinkler System Flow and Tamper Valves.
    - d. Knox Box.
    - e. Magnetic Door Holders.
    - f. Spark Detection for Duct Collection System.
      - 1) Where spark detection is indicated on the drawings, provide the required fire alarm connection at this location. Review with the local fire marshal exact sequence of operations.
      - 2) Coordinate connection requirements with the spark detection installing contractor.
  8. Remote Annunciation and Control.
  9. Firefighter's microphone shall be located near administration area, where directed by the owner in the field. Provide all accessories, wiring, programming, etc. as required.
  10. Remote Network panels.
  11. Smoke/Heat Detectors.
  12. Manual Pull Stations.
  13. Visual Indicating Appliances.
  14. Audible Indicating Appliances. (Speakers)
  15. Central Station Reporting of Alarm, Trouble and Supervisory Conditions.
  16. Standby Batteries.
  17. Record documents in Document Storage Box.
  18. Conduit, Wire (low and line), Outlet Boxes, Miscellaneous Parts.
  19. Other items required for a complete and operational system.
- B. The Contractor shall be responsible for submitting all drawings, riser diagrams, calculations etc. to local authority for their approval. All components require U.L. and FM compliance. The Contractor shall be required to provide UL and FM certification documentation to township officials to meet all township requirements before the township will accept the system. The Contractor



shall be responsible to review all annunciator, Knox Box and sprinkler gong locations with local officials prior to beginning work. The Contractor shall be responsible for any and all permits required by the township.

- C. The Contractor shall verify that all peripheral devices (initiation and annunciation) is compatible with the system. If an alternate manufacturer of peripheral device is required for compatibility with the system, the contractor shall supply the alternate manufacture at no additional cost to the Owner. The alternate manufactured device shall be equivalent in performance and appearance to the specified.
- D. Provide interconnections as listed in part 2.
- E. Provide training as listed in part 3.

## 1.2 CODES AND STANDARDS

- A. NEC Compliance: Comply with the National Electric Code (NEC), latest version in effect as of the bid due date of this project, as applicable to construction and installation of fire alarm and detection system components and accessories.
- B. The Fire Alarm System Supplier shall contract with an independent Electrical Inspection Agency to inspect the fire alarm system installation for compliance with Article 760 of the NEC and other applicable articles of the NEC. The Inspection Agency shall be a different company than the Electrical Inspection Agency used by the Electrical Contractor. An approval certificate from the Electrical Inspection Agency shall be submitted to the Architect and Engineer before final approval of the system is granted.
- C. The name of the Electrical Inspection Agency is to be submitted with the shop drawings for approval by the Architect and Engineer of record for this project.
- D. NFPA Compliance: Comply with latest edition of NFPA 72 National Fire Alarm Code, as applied to construction and installation of fire alarm and detection system components and accessories. The Contractor shall be responsible to have the Fire Alarm manufacturer review the drawings prior to installation of any device. Any device(s) required to be added or relocated to meet NFPA requirements shall be submitted prior to installation.
- E. ADA Compliance: Provide fire alarm system signaling components which meet the Americans with Disabilities Act (ADA) and any subsequent modifications and clarifications to this law.
- F. U.L Compliance and Labeling: Provide fire alarm and detection system components which are U.L. listed and labeled for their intended use and service. In addition to the fire alarm equipment listing requirements, if the local municipality requires, the Fire Alarm System Equipment Supplier shall be U.L. listed as an Alarm Service Company for Local, Remote, Auxiliary and Proprietary Protective Signaling Systems. The U.L. Listing Certification number for the Alarm Service Company shall be included in the submittal information.
- G. Commonwealth of Pennsylvania: The complete installation shall be installed in a manner to provide a system that meets the requirements of the Pennsylvania Construction Code Act (Title 34) as adopted on April 11, 2003 and the Uniform Construction Code.
- H. Local Code Requirements: Comply with the latest codes as adopted by the local code authority having jurisdiction (AHJ) and implemented by its building code services bureau. The Contractor and equipment supplier shall assist the building code services bureau inspectors in the final test of equipment and operation of the system.

- I. NICET Certification: The Equipment Supplier shall employ at least one individual full time in the office supporting this project that has attained NICET Level III Certification in Fire Alarm Systems. All submittals and drawings shall be approved, initialed and show the NICET Certification Number of the individual maintaining the certification and taking responsibility for the documentation. As an alternate to the NICET Level III requirement, all submittals, drawings, and testing shall be reviewed, witnessed, and stamped sealed by a Professional Engineer (PE), licensed in the State of Pennsylvania, and the PE shall present a final letter of certification of the system at the completion of the project.

While the system has been designed as part of the bidding documents, it is the Vendor's responsibility to review all equipment locations to ensure compliance with the supplied products. The Vendor shall also provide all required battery calculations, wiring requirements, etc. for a complete and functioning code compliant system. Should a deficiency be found during the review process, the Vendor shall submit, in writing, all deficiencies for Engineer review.

### 1.3 DESCRIPTION OF WORK

- A. It is the intent of these Specifications and Drawings to describe the minimum requirements to extend the existing main building fire alarm system to the new welding building. Furnish and install All required devices, equipment and wiring (low & line). The system shall be addressable type to include manual stations, automatic detectors, visual indicating appliances, audible indicating appliances, equipment and connections for remote Central Station monitoring, sprinkler flow and tamper switch monitoring, duct detectors, air handling unit control, standby batteries, conduit, wire, outlet boxes, door hold open devices, and any other items required to provide a complete and operational system.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A factory authorized installer is to perform the work of this section. The authorized installer shall include a service department and employ factory trained and NICET certified technicians, and shall be located within 100 miles of this project location. The installer shall have a minimum of 5 years' experience installing fire protective signaling systems.
- B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.
- C. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems.

### 1.5 SUBMITTALS

- A. Submit under provisions of Division 26 "Basic Electrical Requirements."
- B. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:
  1. Detailed written system description describing system functions and operation. All specification deviations shall be clearly noted and marked.
  2. Control panel wiring schematic and interconnections.
  3. Complete point to point wiring diagram showing terminal connections to all system devices.

4. Riser wiring diagram and associated zones.
  5. Complete floor plan drawings locating all devices associated with the fire alarm system.
  6. Factory data sheets on which piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
  7. Complete Bill of Material for reference.
  8. Programming matrix defining all input/output functions and zoning.
  9. Provide complete battery calculations for both alarm and supervisory mode.
  10. Provide audibility calculations shop drawings per IFC 907.
- C. The equipment supplier must have a minimum NICET Level 3 Certification, or Submittals and Drawings must be stamped by a Registered Fire Protection Engineer.
- D. Submit a copy of NICET Level III Certificate and technician's factory certification cards.
- E. All submittal data will be in bound form with contractor's name, supplier's name, project name, and State Fire Alarm License number adequately identified.
- F. When preparing submittals and any required final programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers.
- G. **Project Completion Documentation:**
1. At the completion of the project, the following documentation shall be provided in compliance to Division 26 "Basic Electrical Requirements" and Division 01 sections, as well as included in the Document Storage Box:
    - a. Complete set of Operation and Maintenance manuals.
    - b. Program documentation as specified in this section.
    - c. Complete set of As-Built fire alarm drawings, indicating all device programming and identification, and battery calculations. Drawings must include all newly installed equipment, as well as any existing equipment scheduled to remain.
    - d. All other NFPA and UCC required documentation.
- 1.6 WARRANTY AND MAINTENANCE SERVICE
- A. The Contractor shall warrant the fire alarm equipment and wiring to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of the final acceptance of the system of the last phase of the project. The Fire Alarm System equipment shall have a warranty of two (2) years from date of the last phase of the project. Defective equipment shall be replaced at no cost to the Owner during this two-year warranty period.
- B. Maintenance Service Contract: Provide warranty maintenance of fire alarm systems and equipment for a period of two (2) years, using factory-authorized service representatives.
- C. Basic Services: Systematic, routine maintenance visits on at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.
- D. Additional Services: Perform services within the above period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

- E. Testing & Inspections: Perform NFPA 72 and the Pennsylvania Department of Labor & Industry, Uniform Construction Code required testing and inspections during the two (2) year period at no additional cost to the owner.
- F. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

**1.7 ADDITIONAL DOCUMENTATION AND PROGRAMMING REQUIREMENTS**

- A. The vendor shall provide drawings showing all fire alarm devices and their device identification in the software. These drawings must include all devices, whether shown on the project drawings, or not, and shall include any existing devices that are remaining to be reused.
- B. At the end of the project, the vendor shall program all device point identification to match existing room numbering at the completion of the project.
- C. At project completion, all of the above documentation shall be provided as part of the operation and maintenance manuals and as-built documentation.

**1.8 ADDITIONAL DEVICES**

- A. The contractor shall include in the bid, the cost to furnish and install the following devices. The contractor shall assume final finish as been applied and include 100' of wiring, backboxes, conduit, etc. required for installation. Any devices not installed; the contractor shall turn over to the owner as spare stock:
  - 1. Manual Stations: Two (2) devices.
  - 2. Wall Mounted Strobe Units: Three (3) devices.
  - 3. Ceiling speakers: Three (3) devices.
  - 4. Wall Mounted Audible/Visual Units: Three (3) devices.
  - 5. Ceiling Mounted Audible/Visual Units: Three (3) devices.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Siemens. (Existing System Extended) Contact Berkshire Systems Group (610-775-1200)**

**2.2 FIRE ALARM AND DETECTION SYSTEMS**

- A. General: Provide fire alarm and detection system products of types, sizes and capacities indicated that comply with manufacturer's standard design, materials, and components; construct in accordance with published product information, and as required for complete installation. Provide fire alarm and detection systems for applications indicated, and with the following sequence of operations, components and function features.
- B. The system shall be addressable type, to include manual stations, automatic detectors, visual indicating appliances, audible indicating appliances, remote annunciators, equipment and connections for remote monitoring, sprinkler flow switch, sprinkler tamper switch, duct detector,

standby batteries, conduit, wire, outlet boxes and any other items required to provide a complete and operational system.

## 2.3 MATERIALS AND EQUIPMENT

### A. Remote Fire Alarm Control Panel:

1. Provide a remote fire alarm control panel cabinet as shown on the drawings that includes the required power supply. The Contractor shall provide 120V power supply as required.
  - a. Provide in a surface mounted enclosure when installed in mechanical or electrical space. When located in a finished location, provide recessed enclosure.

### B. Signal Panel:

1. Provide Signal Panel PAD-49 in enclosure required.

### C. Fire Alarm Annunciator Panel:

Provide a flush Fire Alarm Annunciator panel in Main Lobby of the building.

### D. Off-Site Communications:

1. Offsite communications shall be provided through the existing buildings fire alarm panel/system. Provide telephone wiring as required.

### E. Initiation Devices:

1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections on either Style 4 or Style 6 circuits.
2. Smoke Detectors:
  - a. Smoke detectors shall be ceiling mounted digital addressable photoelectric type smoke detectors with integrated heat sensors. The combination detector head and twist lock base shall be U.L. listed compatible with the fire alarm control panel.
  - b. The base shall permit direct interchange with the heat detector. The base shall be the appropriate twist lock base.
  - c. The smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment.
  - d. The vandal security-locking feature shall be used in those areas as indicated on the drawing. The locking feature shall be field selectable when required. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits.
  - e. Detectors shall have completely closed back to restrict entry of dust and air turbulence and have a 30-mesh insect screen. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I. Provide Siemens OOH941 W/DB-11 Base
3. Combination Fire and Carbon Monoxide Detectors:

- a. Combination fire and carbon monoxide detectors shall be ceiling mounted digital addressable detectors with integrated sensing elements, including smoke, CO, light/flame and heat. The detector head and twist lock base shall be U.L. listed compatible with the fire alarm control panel.
  - b. The smoke detector shall have a flashing status LED for visual supervision. The detector may be reset by actuating the control panel's reset switch. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment.
  - c. The vandal security-locking feature shall be used in those areas as indicated on the drawing. The locking feature shall be field selectable when required. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits.
4. Duct Detectors:
- a. Duct Detector shall include an enclosure with a photoelectric smoke head as previously specified and auxiliary output. Duct Detectors shall be provided with remote indicator lights and appropriate sampling tube for duct size.
  - b. Duct Detectors shall be provided with NEMA 4X enclosure and strip heat as required for exterior applications, powered from the fire alarm system. Provide sufficient power and wire as required to operate detector.
  - c. Program duct detectors as directed by owner/fire marshal.
  - d. Provide Siemens FDBZ492.
5. Beam Smoke Detectors:
- a. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.
  - b. Detector Address: Accessible from FACP and able to identify detector's location within system and its sensitivity setting.
  - c. Operator at FACP, having designated access level, must be able to manually access the following for each detector:
    - 1) Primary status.
    - 2) Device type.
    - 3) Present average value.
    - 4) Present sensitivity selected.
    - 5) Sensor range (normal, dirty, etc.)
  - d. For detectors that require additional power, provide power as required for full functionality.
6. Manual Pull Stations:
- a. Manual Fire Alarm Stations shall be double action type, with a key operated test-reset lock in order that they may be tested, and so designed that after actual emergency operation, they cannot be restored to normal except by use of a key. The reset key shall be so designed that it will reset manual station and open FACP without use of another key. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of fifty feet, front or side. Manual stations shall be constructed with clearly visible operating instructions on the front of the stations in raised letters. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting on a standard single-gang box, and shall be installed within the limits defined by the Americans

- with Disabilities Act (ADA) dependent on manual station accessibility or per local requirements.
- b. Manual Fire Alarm Stations shall utilize push in/pull down operation.
  - c. Housing material shall be metal or LEXAN polycarbonate resin.
  - d. Provide Siemens XMS-S.
7. Addressable Interface Devices:
- a. Addressable Interface devices compatible with the system shall be provided to monitor contacts for such items as water-flow, tamper, pressure, and PIV switches, Knox Box, Air Handling Unit Fans that are required by codes to be controlled, connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required, the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive.
- F. Notification Appliances:
1. Finishes:
    - a. All ceiling devices shall be white with red lettering, unless noted otherwise.
    - b. All wall mounted devices shall be white with red lettering, unless noted otherwise.
  2. The speaker/strobe or speaker appliance as indicated on the drawings shall be a multiple tap speaker having taps for ¼, ½, 1 and 2 watts. The speaker/strobes shall have a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15, 30, 75, and 110 candela. Do not load any circuit beyond 75 % of its capacity. Provide Siemens SLSPSW-F
  3. The strobe only appliance as indicated on the drawings shall be a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15, 30, 75, and 110 candela. Do not load any circuit beyond 75 % of its capacity. Provide Siemens SLSCW-F
  4. Where shown on the drawings, provide strobe units in combination with the audible indicating appliances. Strobes shall be supervised and synchronized within each circuit. Provide protective guards for all strobes located in Locker Rooms.
  5. An alarm extender panel shall be provided where needed. The power supply shall be a minimum of 8 amps. The power supply shall contain four supervised notification circuits strobes and audibles. There shall be a 1 amp filtered auxiliary power limited output.
  6. Provide Weatherproof Strobe, Speaker and Speaker/Strobe Units with NEMA 4X enclosures when located exterior of the building and where indicated on the drawings. These units shall have the same feature as speaker/strobe unit mentioned above and shall be weatherproof and rated for outdoor use. Furnish with surface weatherproof backbox.
  7. Where notification appliances are indicated, provide manufacturer approved weather proof enclosures, etc.
  8. Where devices are indicated to be installed in the ceiling, provide comparable devices designed to be installed in the ceiling.
  9. Where devices are indicated to be installed on walls requiring surface installation in lieu of recessed, devices shall be mounted using a manufacturer's prescribed matching enamel outlet box. Finish of box shall match device.
- G. Other Conditions:
1. After installation of smoke detectors, in potentially dusty areas, the Contractor shall provide an airtight plastic cover over the units to keep contaminants from entering the unit in all

areas, until time of acceptance. It is the responsibility of the Contractor to either clean or replace any devices that have become soiled or contaminated by construction dirt.

2. The fire alarm equipment distributor shall stock the recommended spare parts listed for the UL certification.
- H. Knox Box: Provide recessed (surface on existing wall) Knox Box, meeting Authority Having Jurisdiction (City of Reading) requirements. Provide connection to fire alarm system.
- I. Annunciator: Provide a flush mounted annunciator. Electrical Contractor shall verify exact location of annunciators with local authority having jurisdiction prior to installing. Annunciator shall provide full device information during alarm, trouble and supervisory conditions. Affected device shall be identified with location in the building.
- J. Door Holders: Provide 24 VDC magnetic door holders and connect to the fire alarm door control circuit. The door holders shall be wall mounted unless otherwise noted on the drawings. The door holders shall be controlled for fail safe operation and shall not hold open during normal power failure. Provide with finish matching door hardware.

## 2.4 INTERCONNECTIONS

- A. Connection to the Lighting Control System: Provide auxiliary relay to connect to the Lighting Control System. This relay shall be programmed to indicated to the lighting control system when the building goes into alarm so that all of the connected lights can go to full output. Coordinate the exact requirements with the Lighting Control System manufacturer.

## PART 3 - INSTALLATION

### 3.1 GENERAL

- A. Examine areas and conditions under which fire alarm system is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Install system and materials in accordance with manufacturer's instructions and rough-in drawings, and details on the drawings. Install electrical work and use electrical products of these specifications.
- C. The Contractor shall install backboxes flush in wall with conduit to above accessible ceilings for fire alarm system. The contractor shall coordinate locations and backbox sizes.
- D. This contractor is responsible for furnishing and installing all devices in ceiling tiles, including but not limited to backboxes, and supports.
- E. In addition to providing smoke detectors at the locations indicated on the drawings, and within these specifications, smoke detectors shall be provided at all fire alarm control units and transponders, notification appliance circuit power extenders, supervising station transmitting equipment and other NFPA and IFC required areas.
- F. Install Document Storage Box near main FACP. Field verify with Owner exact location.



**3.2 LABELING**

- A. All devices shall be labeled with their device point identification, matching the program ID. Provide loop identification for devices without specific point identification.
- B. For devices located above the ceiling, provide identification of the device, as well as on the T-bar directly below the device. Identification information shall also be provided on remote indicators installed for duct detectors.
- C. Devices requiring power (FACP, remote battery cabinets, etc.) shall be provided with label of circuit feeding device.

**3.3 EQUIPMENT INSTALLATION**

- A. Notification Appliances: Mount semi-flush in recessed backboxes. Where surface mounting is approved, use manufacturer's standard surface backbox with finish matching device (provide red for red devices and white for white devices).
  - 1. The use of pre-punched, or standard galvanized 4" square boxes shall not be acceptable under any circumstances.
- B. Manual Pull Stations: Mount semi-flush in recessed back boxes. Where surface mounting is approved, use manufacturers standard surface Red backbox.
  - 1. The use of pre-punched, or standard galvanized 4" square boxes shall not be acceptable under any circumstances.
- C. Ceiling Mounted Smoke Detectors: Not less than 4" from a side wall to the near edge. For exposed solid-joist construction, mount detectors on the bottom of joists. On smooth ceilings, install not more than 30 ft. apart in any direction.
- D. Notification Appliances: Mount semi-flush in recessed backboxes. Where surface mounting is approved, use manufacturer's standard surface backbox with finish matching device (provide red for red devices and white for white devices).
  - 1. The use of pre-punched, or standard galvanized 4" square boxes shall not be acceptable under any circumstances.
- E. Audible Alarm Indicated Devices: Install not less than 6" below the ceiling. Install Speakers on flush mounted back boxes with the device operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.
- F. Visible Alarm Indicated Devices: Install at least 6" below the ceiling and at a Maximum height of 96 inches.
- G. FACP or Remote Network Panel: Install with tops of cabinets not more than 72" above the finished floor. Verify exact height with local authority having jurisdiction.
- H. Annunciator: Install with the top of the panel not more than 72" above the finished floor. Verify exact height with local authority having jurisdiction.
- I. Notification Appliances: Mount semi-flush in recessed backboxes. Where surface mounting is approved, use manufacturer's standard surface backbox with finish matching device (provide red for red devices and white for white devices).

- J. Remote Battery Panels: Install in mechanical or electrical spaces when available. Janitor closets may be used, if installed high on wall, away from water. Only use storage closets when necessary, and install high and out of the way of Owner storage space.

### 3.4 WIRING

- A. Wiring connections shall be made by the Contractor as shown on drawings furnished by the representative of the equipment manufacturer. Power shall not be applied to the system until the representative of the manufacturer has approved the connections to the control equipment.
- B. The system shall be installed in a manner approved by the State Inspections Department and the National Electric Code utilizing approved raceways or approved fire alarm cable.
- C. Power for all fire alarm devices, including, but not limited to control panel, remote battery panels, initiation devices and annunciation devices, 120V and less shall be provided. Any power at 120V shall be connected to the nearest available panelboard on a 20A, 1P breaker. Provide a handle locking devices. The breaker or breakers for the fire alarm system shall be clearly marked.
- D. All fire alarm cabling shall be plenum rated. Contractor shall install in a code compliant method. Fire alarm cable shall **not** be installed in the cable tray or with data cabling within J-hooks.
- E. Fire alarm circuit identification shall meet N.E.C. Article 760.

### 3.5 FIELD QUALITY CONTROL

- A. The manufacturer shall provide local representative to review the system installation with installers to assure proper wiring and installation methods are used. Job visits shall be made by representatives of the equipment manufacturer as necessary through construction.
- B. Demonstration of System Operation: After adjustments to the system have been completed, arrange for a demonstration of the system operation for personnel designated by the Owner.
- C. Notify in writing through the prime Contractor, the Architect, Consulting Engineer and the Owner of the time and date the demonstration will take place. Provide a technician representing the equipment manufacturer to conduct the system demonstration.
- D. Pre-Testing: After installation, align, adjust, and balance the system and perform complete pre-testing. Determine, through pre-testing, the compliance of the system with requirements of drawings and specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- E. Report of Pre-Testing: After pre-testing is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.
- F. Final Test Notice: Provide a minimum of five (5) days' notice in writing when the system is ready for final acceptance testing.
- G. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:
  - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
  - 2. Test all conductors for short circuits using an insulation testing device.

3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawing.
4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10% of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequence. Observe indicating lights, displays, signal tones, and Annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

- H. Re-Testing: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets specifications and complies with applicable standards.
- I. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.
- J. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

### 3.6 TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
  1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
  2. Schedule training with the Owner at least seven days in advance.

### 3.7 SEQUENCE OF OPERATIONS

- A. In additions to the operations and functions listed, the following shall also occur:
  1. Where duct mounted smoke detectors are indicated specifically for air handling unit control, the associated air handling unit shall be connected to the fire alarm system via interface module. An auxiliary relay base shall not be used, unless noted otherwise.
    - a. Upon a duct mounted smoke detector alarm condition, the connection to the mechanical equipment's starter via interface module shall shut down its respective unit. A supervisory signal shall be sent to the fire alarm control panel which in turn will send a signal to the automatic temperature control (ATC) system. The ATC

system, depending on its programming, may shut down all or some of the other mechanical equipment in the building.

**3.8 TOWNSHIP/FIRE MARSHAL DRAWINGS**

- A. The Contractor shall provide CADD Drawings on 8 ½" x 11" (or as otherwise required by the local Fire Marshall or authority) sheets showing all As-Built device locations with identification numbers attached. These Drawings shall show all devices within the building. These Drawings shall be turned over to the township representative/Fire Marshal for their approval.

END OF SECTION 284621



## SECTION 311000 - SITE CLEARING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 017300 "Execution" for field engineering and surveying.
3. Section 017419 "Construction Waste Management" for disposal of demolished materials.
4. Section 024119 "Selective Demolition" for partial demolition of buildings or structures.

#### 1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing. Use sufficiently detailed photographs or video recordings.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises **where indicated**.
- C. Utility Locator Service: Notify utility locator service and **One Call** for area where Project is located before site clearing.
1. Contractor shall provide a qualified utility locator service to identify underground utility locations on School District property not served by "One Call" services.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction. Restore damaged improvements to their original condition, as acceptable to Owner.
- C. Protect existing site improvements to remain from damage during construction.
  1. Restore damaged improvements to their original condition, as acceptable to Owner.

#### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### 3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed **or abandoned in place**.
  1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  1. Notify Architect not less than **two** days in advance of proposed utility interruptions.
- C. Excavate for and remove underground utilities indicated to be removed.



### 3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots larger than **2 inches (50 mm)** in diameter, obstructions, and debris to a depth of **18 inches (450 mm)** below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.
  - 4. Chip removed tree branches and **dispose of off-site**.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of **8 inches (200 mm)**, and compact each layer to a density equal to adjacent original ground.

### 3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth **indicated on Drawings** in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than **2 inches (50 mm)** in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Do not stockpile topsoil within protection zones.

### 3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
  
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000



## SECTION 312000 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for **slabs-on-grade, walks, pavements**, and turf and grasses.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete **walks and pavements**.
6. Subbase course **and base course** for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

##### B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" Section 013233 "Photographic Documentation" for recording preexcavation and earth-moving progress.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping **and stockpiling** topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

#### 1.2 UNIT PRICES

- ##### A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

#### 1.3 DEFINITIONS

- ##### A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- ##### B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- ##### C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- ##### D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- ##### E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **unit prices**.
  - 2. Bulk Excavation: Excavation more than **10 feet (3 m)** in width and more than **30 feet (9 m)** in length.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at **Project site**.
  - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
    - a. Personnel and equipment needed to make progress and avoid delays.
    - b. Coordination of Work with utility locator service.
    - c. Extent of trenching by hand or with air spade.
    - d. Field quality control.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
  - 1. Controlled low-strength material, including design mixture.
  - 2. Warning tapes.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each **on-site and borrow** soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.

B. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

#### 1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify **utility locator service** and "**One Call**" for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and **Section 311000 "Site Clearing"** are in place.

D. The following practices are prohibited within protection zones:

E. Storage of construction materials, debris, or excavated material.

F. Parking vehicles or equipment.

G. Foot traffic.

H. Erection of sheds or structures.

I. Impoundment of water.

J. Excavation or other digging unless otherwise indicated.

K. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

L. Do not direct vehicle or equipment exhaust towards protection zones.

M. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

#### PART 2 - PRODUCTS

##### 2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Subbase Material: PA No. 2A aggregate, PA DOT Type "A" or "B".
- C. Base Course: AASHTO No. 57 or 67 aggregate, PA DOT Type "A" or "B".
- D. Bedding Course: PA No. 2A aggregate, PA DOT Type "A" or "B".
- E. Drainage Course: Narrowly graded mixture of crushed stone or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.
- F. Sand: ASTM C33/C33M; fine aggregate.

## 2.2 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
  - B. Portland Cement: ASTM C150/C150M, Type I.
  - C. Fly Ash: ASTM C618, Class C or F.
  - D. Normal-Weight Aggregate: ASTM C33/C33M, 3/8-inch (10-mm) Insert dimension nominal maximum aggregate size.
  - E. Foaming Agent: ASTM C869/C869M.
  - F. Water: ASTM C94/C94M.
  - G. Air-Entraining Admixture: ASTM C260/C260M.

## 2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.

5. Green: Sewer systems.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

#### 3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

#### 3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

#### 3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.



### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus **1 inch (25 mm)**. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus **1 inch (25 mm)**. Do not disturb bottom of excavations intended as bearing surfaces.

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to **12 inches (300 mm)** higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: **12 inches (300 mm) each side of pipe or conduit.**
- C. Trench Bottoms:
  - 1. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

### 3.8 SUBGRADE INSPECTION

- A. Coordinate excavation activities with Owner's site inspection/testing company and with local authorities. Provide timely notice to inspecting agencies for access to perform required testing and inspections.
- B. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **unit prices**.

- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### 3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of **2500 psi (17.2 MPa)**, may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### 3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring, bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within **18 inches (450 mm)** of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Backfill voids with satisfactory soil while removing shoring and bracing.

- E. Warning Tape: Install warning tape directly above utilities, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

### 3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **8 inches (200 mm)** in loose depth for material compacted by heavy compaction equipment and not more than **4 inches (100 mm)** in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to **ASTM D698**:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches (300 mm)** of existing subgrade and each layer of backfill or fill soil material at **95** percent.
  - 2. Under walkways, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at **92** percent.
  - 3. Under turf or unpaved areas, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at **85** percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at **85** percent.

### 3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
1. Turf or Unpaved Areas: Plus or minus **1 inch (25 mm)**.
  2. Walks: Plus or minus **1 inch (25 mm)**.
  3. Pavements: Plus or minus **1/2 inch (13 mm)**.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.
- 3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS
- A. Place subbase course **and base course** on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course **and base course** under pavements and walks as follows:
1. Place base course material over subbase course under hot-mix asphalt pavement.
  2. Shape subbase course **and base course** to required crown elevations and cross-slope grades.
  3. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than **95** percent of maximum dry unit weight according to **ASTM D698**.
- 3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE
- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  2. Place drainage course **6 inches (150 mm)** or less in compacted thickness in a single layer.
  3. Place drainage course that exceeds **6 inches (150 mm)** in compacted thickness in layers of equal thickness, with no compacted layer more than **6 inches (150 mm)** thick or less than **3 inches (75 mm)** thick.
  4. Compact each layer of drainage course to required cross sections and thicknesses to not less than **95** percent of maximum dry unit weight according to ASTM D698.
- 3.19 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

### 3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Hot-mix asphalt paving.
- 2. Hot-mix asphalt overlay.
- 3. Hot-mix asphalt patching.

- B. Related Requirements:

- 1. Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
- 2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
- 3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
  - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
  - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Include technical data and tested physical and performance properties.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

- B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
  - 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
  - 3. Slurry Coat: Comply with weather limitations in ASTM D3910.
  - 4. Asphalt Base Course and Binder Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
  - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
  - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: ASTM D6373 binder designation PG 58-28.
- B. Cutback Prime Coat: ASTM D2027/D2027M, medium-curing cutback asphalt, MC-30 or MC-70.
- C. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- D. Water: Potable.
- E. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

### 2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles or glass from sources

and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Joint Sealant: ASTM D6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

## 2.4 MIXES

- A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes designed in accordance with procedures in AI MS-2, "Asphalt Mix Design Methods"; and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Provide mixes that comply with requirements identified on Site Construction details.
    - a. Base Course: Superpave Asphalt Mixture Design HMA or WMA Base Course, Pg. 64-22, 0.3 mill to <3.0 mill ESALS, 25 mm Mix.
      - 1) Depth as indicated on drawings.
    - b. Binder Course: Superpave Asphalt Mixture Design HMA or WMA Base Course, Pg. 64-22, 0.3 mil to <3.0 mill ESALS, 9.5 mm Mix.
      - 1) Depth as indicated on drawings.
    - c. Wearing Course: Superpave Asphalt Mixture Design HMA or WMA Wearing Course, Pg. 64-22, 0.3 mil to <3.0 mill ESALS, 9.5 mm Mix, SRL-L.
      - 1) Depth as indicated on drawings.
- B. Emulsified-Asphalt Slurry: ASTM D3910, Type 1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to **3 mph (5 km/h)**.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

### 3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending **12 inches (300 mm)** into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of **0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m)**.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

### 3.4 SURFACE PREPARATION

- A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
  - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of **0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m)**. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
  - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  - 2. Protect primed substrate from damage until ready to receive paving.

- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.5 HOT-MIX ASPHALT PLACEMENT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course[ and binder course] in number of lifts and thicknesses indicated.
  2. Place hot-mix asphalt surface course in single lift.
  3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
  4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
  2. Complete a section of asphalt base course and binder course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
  3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
  4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
  5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
  - 2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
  - 1. Base Course and Binder Course: Plus or minus 1/2 inch (13 mm).
  - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course and Binder Course: 1/4 inch (6 mm).
  - 2. Surface Course: 1/8 inch (3 mm).

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is **1/4 inch (6 mm)**.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.
  1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
  2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
    - a. One core sample will be taken for every **1000 sq. yd. (836 sq. m)** or less of installed pavement, with no fewer than three cores taken.
    - b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.10 WASTE HANDLING

- A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216



## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes concrete paving **including the following:**
  - 1. Curbs and gutters.
  - 2. Walks.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
  - 2. Section 321726 "Tactile Warning Surfacing" for detectable warning **tiles**.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
  - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
    - a. Concrete mixture design.
    - b. Quality control of concrete materials and concrete paving construction practices.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

B. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control

- temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, **steel reinforcement**, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with **ACI 301 (ACI 301M)** unless otherwise indicated.

### 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  1. Use flexible or uniformly curved forms for curves with a radius of **100 feet (30.5 m)** or less. **Do not use notched and bent forms.**
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### 2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from **galvanized-steel** wire into flat sheets.
- B. Reinforcing Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**; deformed.
- C. Joint Dowel Bars: ASTM A615/A615M, **Grade 60 (Grade 420)** plain-steel bars. Cut bars true to length with ends square and free of burrs.
- D. Tie Bars: ASTM A615/A615M, **Grade 60 (Grade 420)**; deformed.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

### 2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
  1. Portland Cement: ASTM C150/C150M, **gray** portland cement **Type I**.



2. Fly Ash: ASTM C618, **Class C or Class F**.
- B. Normal-Weight Aggregates: ASTM C33/C33M, **Class 4M**, uniformly graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: **1 inch (25 mm)** nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  3. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
- E. Water: Potable and complying with ASTM C94/C94M.

## 2.5 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

## 2.6 RELATED MATERIALS

- A. Joint Fillers: **ASTM D1751, asphalt-saturated cellulosic fiber** in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to **ACI 301 (ACI 301M)**, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
- B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
  1. Air Content, **1-inch (25-mm)** Nominal Maximum Aggregate Size: **6** percent plus or minus 1-1/2 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to **0.15** percent by weight of cement.

- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use **high-range, water-reducing admixture** in concrete as required for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Concrete Mixtures: Normal-weight concrete.
  - 1. Compressive Strength (28 Days): **4000 psi (27.6 MPa)**.
  - 2. Maximum W/C Ratio at Point of Placement: **0.50**.
  - 3. Slump Limit: **5 inches (125 mm)**, plus or minus **1 inch (25 mm)**.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When air temperature is between **85 and 90 deg F (30 and 32 deg C)**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F (32 deg C)**, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
  - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
  - 1. Butt Joints: Use **bonding agent** at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of **50 feet (15.25 m)** unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler not less than **1/2 inch (13 mm)** or more than **1 inch (25 mm)** below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a **1/4-inch (6-mm)** radius. Repeat grooving of contraction joints after applying surface finishes.
    - a. Tolerance: Ensure that grooved joints are within **3 inches (75 mm)** either way from centers of dowels.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3-mm-)** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within **3 inches (75 mm)** either way from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a **1/4-inch (6-mm)** radius. Repeat tooling of edges after applying surface finishes.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with **ACI 301 (ACI 301M)** requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to **ACI 301 (ACI 301M)** by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating joint devices.
- H. Screed paving surface with a straightedge and strike off.

- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
  - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface **1/16 to 1/8 inch (1.6 to 3 mm)** deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.8 INSTALLATION OF DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."
  - 1. Tolerance for Opening Size: **Plus 1/4 inch (6 mm), no minus.**
- B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

### 3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching **0.2 lb/sq. ft. x h (1 kg/sq. m x h)** before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by **moisture curing, moisture-retaining-cover curing, curing compound or a combination of these** as follows:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with **12-inch (300-mm)** lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least **12 inches (300 mm)**, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.10 PAVING TOLERANCES

- A. Comply with tolerances in **ACI 117 (ACI 117M)** and as follows:
  - 1. Elevation: **3/4 inch (19 mm)**.
  - 2. Thickness: Plus **3/8 inch (10 mm)**, minus **1/4 inch (6 mm)**.
  - 3. Surface: Gap below **10-feet- (3-m-)** long; unlevelled straightedge not to exceed **1/2 inch (13 mm)**.
  - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: **1/2 inch per 12 inches (13 mm per 300 mm)** of tie bar.
  - 5. Lateral Alignment and Spacing of Dowels: **1 inch (25 mm)**.
  - 6. Vertical Alignment of Dowels: **1/4 inch (6 mm)**.
  - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: **1/4 inch per 12 inches (6 mm per 300 mm)** of dowel.
  - 8. Joint Spacing: **3 inches (75 mm)**.
  - 9. Contraction Joint Depth: Plus **1/4 inch (6 mm)**, no minus.
  - 10. Joint Width: Plus **1/8 inch (3 mm)**, no minus.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each **25 cu. yd.** or fraction thereof of each concrete mixture placed each day.

- a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
    - a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
  - C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  - D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  - E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  - F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - G. Concrete paving will be considered defective if it does not pass tests and inspections.
  - H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - I. Prepare test and inspection reports.
- 3.12 REPAIR AND PROTECTION
- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313





## SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Cold-applied joint sealants.
- 2. Joint-sealant backer materials.
- 3. Primers.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

#### 1.7 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.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. **Compatibility:** Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

### **2.2 COLD-APPLIED JOINT SEALANTS**

- A. **Single Component, Pourable, Urethane, Elastomeric Joint Sealant:** ASTM C 920, Type S, Grade P, Class 25, for Use T.
  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. W. R. Meadows, Inc.

### **2.3 JOINT-SEALANT BACKER MATERIALS**

- A. **Joint-Sealant Backer Materials:** Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. **Backer Strips for Cold- and Hot-Applied Joint Sealants:** ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

### **2.4 PRIMERS**

- A. **Primers:** Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

## **PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

**3.3 INSTALLATION OF JOINT SEALANTS**

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of joint-sealant backings.
  - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
  - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
  - 1. Place joint sealants so they fully contact joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

### 3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

### 3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.
1. Joint Location:
    - a. Expansion and isolation joints in concrete paving.
    - b. Contraction joints in concrete paving.
    - c. Joints between concrete and asphalt paving.
    - d. Joints between concrete curbs and asphalt paving.
    - e. Other joints as indicated or required to provide joint protection.
  2. Joint Sealant: Single component, pourable, urethane, elastomeric joint sealant.
  3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION 321373

## SECTION 321726 - TACTILE WARNING SURFACING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cast-in-place detectable warning metal tiles.
- B. Related Requirements:
  - 1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.6 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
  - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of **100 deg F (38 deg C)** and higher.

- a. When ambient temperature exceeds **100 deg F (38 deg C)**, or when wind velocity exceeds **8 mph (13 km/h)** and ambient temperature exceeds **90 deg F (32 deg C)**, set unit pavers within 1 minute of spreading setting-bed mortar.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering and wear.
    - b. Separation or delamination of materials and components.
  2. Warranty Period: **Five** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in **[the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1]** for tactile warning surfaces.
  1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Source Limitations: Obtain each type of tactile warning surfacing[, **anchor and fastener**] from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

### 2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
  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. ADA Solutions, a division of SureWerx USA.
    - b. [Advantage Tactile Systems](#).
    - c. [EJ Group, Inc.](#)
    - d. [Neenah Foundry Company](#).
  2. Material:

- a. Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666,
  - 1) Finish and Color:
    - a) Manufacturer's standard powder coat, **safety yellow**.
- 3. Shapes and Sizes:
  - a. Rectangular panel, **24 by 24 inches (610 by 610 mm)**.
- 4. Dome Spacing and Configuration: **Manufacturer's standard compliant spacing**, in **manufacturer's standard** pattern.
- 5. Mounting:
  - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Furnish **Type 316** stainless-steel fasteners for exterior use.
  - 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.



### 3.3 INSTALLATION OF DETECTABLE WARNING TILES

#### A. Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch (3 mm) from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

### 3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

## SECTION 323300 - SITE FURNISHINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings 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. Bollards.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing pipe sleeves cast in concrete footings.
  - 2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop drawings indicating dimensions, foundation requirements, anchoring details, etc.
- C. Samples for Verification: For each type of exposed finish, not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.
  - 1. Include full-size Samples of concrete bollards. Approved samples may be incorporated into the Work.

#### 1.4 CLOSEOUT SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 BOLLARDS: Precast Concrete Bollards – Type 'A' and Type 'B'.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide FS Industries, Providence, RI; Cylinder Series Model TF6020 and Round Concrete Bollard model TF6082, or comparable product by another qualified and established manufacturer with approval by Architect prior to bidding.

B. Bollard Construction:

1. Type 'A' Bollard; 12-inch Diameter, min. by 30-inch height: See drawing for details of selected product.
2. Type 'B' Bollard: 24-inch diameter, min. by 19-inch height; See drawing for details of selected product.
3. Bollard Construction:
  - a. Precast concrete, w/ (4) ½" vertical rebar welded to rebar rings to form cage.
  - b. 4" sch. 40 PVC pipe insert in base for anchoring bollard to steel pipe insert in concrete footing.
  - c. Finish selection by Owner from manufacturer's full line of standard acid wash finish or standard weatherstone.
    - 1) Top of bollard to have smooth finish.
  - d. Style: Manufacturer's standard, Chamfered top, with reveal as indicated on drawings.
4. Installation Method: Provide concrete footing with steel pipe cast in concrete as indicated on drawings.

2.2 MATERIALS

- A. Portland Cement: ASTM C150 specifications.
- B. Aggregates: All aggregates to meet ASTM C33 specifications and to be cleaned of foreign matter and properly graded to size.
- C. Coloring: Pigments used shall be inorganic, resistant to alkalinity and used per manufacturer's recommendations.
- D. Concrete Footing: See Section 033053 "Miscellaneous Cast-In-Place Concrete.
- E. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality materials.
  1. Steel Pipe Anchor: 3" dia., schedule 40 steel pipe, cast in concrete footing.
    - a. Coordinate size and height above grade with manufacturer's directions.
- F. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

- G. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

### 2.3 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, securely anchored, and positioned at locations indicated on Drawings.

END OF SECTION 323300



## SECTION 329200 - TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings 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. Seeding.
  - 2. Erosion-control materials.

#### 1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
  - 1. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than **85** percent germination, not less than **95** percent pure seed, and not more than **0.5** percent weed seed:
  - 2. Full Sun, Warm-Season Grass: Bermudagrass (*Cynodon dactylon*).
  - 3. Full Sun, Cool-Season Grass: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
  - 4. Sun and Partial Shade, Cool-Season Grass: Proportioned by weight as follows:
    - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
    - b. 30 percent chewings red fescue (*Festuca rubra* variety).
    - c. 10 percent perennial ryegrass (*Lolium perenne*).
    - d. 10 percent redtop (*Agrostis alba*).
  - 5. Shade, Cool-Season Grass: Proportioned by weight as follows:
    - a. 50 percent chewings red fescue (*Festuca rubra* variety).
    - b. 35 percent rough bluegrass (*Poa trivialis*).
    - c. 15 percent redtop (*Agrostis alba*).

## 2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition:
    - a. **1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m)** of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
    - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

## 2.3 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.



### 3.3 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds **5 mph (8 km/h)**.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of **3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m)**.
- C. Rake seed lightly into top **1/8 inch (3 mm)** of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding **1:4 with erosion-control blankets** installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas from hot, dry weather or drying winds by applying straw **mulch** within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of **3/16 inch (4.8 mm)**, and roll surface smooth.

### 3.4 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
- B. Mow turf as soon as top growth is tall enough to cut. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

### 3.5 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
  - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding **90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm)**.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.6 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

