

PROJECT MANUAL

FOR

**PALMYRA UNITED METHODIST CHURCH**  
SITE PREP STRUCTURAL BUILDING SHELL BID PACKAGE  
WITH MINOR MEP INFRASTRUCTURE SYSTEMS  
PALMYRA, MISSOURI 63461

PREPARED FOR:

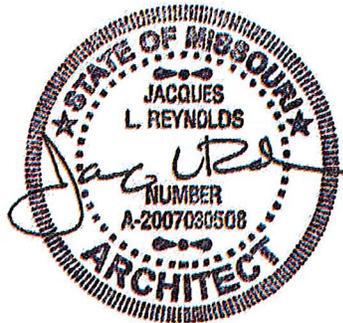
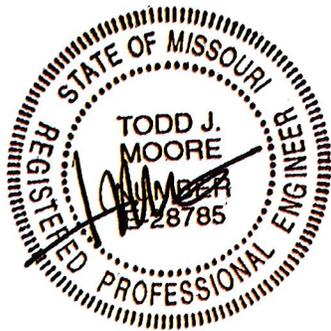
**PALMYRA UNITED METHODIST CHURCH**  
Business 61  
Palmyra, Missouri 63461

BY:

**ARCHITECHNICS**  
510 Maine Street  
Quincy, Illinois 62301

May 17, 2019

State of Missouri Architectural Corporation License #000423  
State of Missouri Engineering Corporation License #02014009673  
Architect / Engineer's Project Number: 5356



Todd J. Moore, PE  
Registered Professional Engineer License E-28785  
License Expires: 12/31/19

05.17.19

Date

**ARCHITECHNICS**  
architects • engineers • interior designers

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**DOCUMENT 00 0101**  
**PROJECT TITLE PAGE**

**1.1 PROJECT MANUAL VOLUME 1**

- A. Site Prep; Structural & Building Shell Bid Package with Minor MEP Infrastructure Systems.
- B. Palmyra United Methodist Church.
- C. Palmyra, Missouri.
- D. Architect Project No. 5356.
- E. Architechnics Inc.
- F. 510 Maine St. FL 10.
- G. Quincy, Illinois, 62301.
- H. Phone: 217-222-0554.
- I. Fax: 217-223-3361.
- J. Website: [www.architechnicsinc.com](http://www.architechnicsinc.com).
- K. Issued: May 17, 2019.

**END OF DOCUMENT 00 0101**

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**DOCUMENT 00 0115**  
**LIST OF DRAWING SHEETS**

**1.1 LIST OF DRAWINGS**

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled Site Prep; Structural & building Shell Package with Minor MEP Infrastructure Systems, dated May 17, 2019, as modified by subsequent Addenda and Contract modifications.

**END OF DOCUMENT 00 0115**

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**DOCUMENT 00 1116  
INVITATION TO BID**

**1.1 PROJECT INFORMATION**

- A. Notice to Bidders: Prequalified bidders are invited to submit bids for Project as described in this Document according to the Instructions to Bidders.
- B. Project Identification: Site Prep; Structural & Building Shell Bid Package with Minor MEP Infrastructure Systems.
  - 1. Project Location: Palmyra, Missouri.
- C. Owner: Palmyra United Methodist Church.
  - 1. Owner's Representative: Doug Aeilts.
- D. Architect: Architechnics, Inc., 510 Maine - 10th Floor, Quincy, Illinois, 62301.
- E. Project Description: Project consists of Building Shell and Site Prep Package.
- F. Construction Contract: Bids will be received for the following Work:
  - 1. General Contract (all trades).

**1.2 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 11, 2019.
  - 2. Bid Time: 2:00 p.m., local time.
  - 3. Location: Office of the Architect, 510 Maine - 10th Floor, Quincy, IL 62301.
- B. Bids will be thereafter privately opened.

**1.3 BID SECURITY**

- A. Bid security shall be submitted with each bid in the amount of 5 percent of the bid amount. No bids may be withdrawn for a period of 60 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

**1.4 PREBID CONFERENCE**

- A. A prebid conference for all bidders will be held at Palmyra United Methodist Church, 110 West Olive St, Palmyra, MO 63461 on May 29, 2019 at 9:00 am, local time. Prospective bidders are requested to attend.

**1.5 DOCUMENTS**

- A. Printed Procurement and Contracting Documents: Obtain after May 17, 2019 by contacting Architect. Documents will be provided to prime bidders only; only complete sets of documents will be issued. Documents will be ordered from reprographic company and mailed to bidder.
  - 1. Fee: \$200.00.
  - 2. Shipping: Additional shipping will apply.
- B. Online Procurement and Contracting Documents: Obtain access after May 17, 2019 by contacting the Architect. Online access will be provided to all registered bidders and suppliers. Online documents are available at no cost to bidders.

**1.6 TIME OF COMPLETION**

- A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.

**1.7 BIDDER'S QUALIFICATIONS**

- A. Bidders must be prequalified by Owner.
- 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.

**END OF DOCUMENT 00 1116**

**DOCUMENT 00 2113  
INSTRUCTIONS TO BIDDERS**

**1.1 INSTRUCTIONS TO BIDDERS**

- A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.
  - 1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

**END OF DOCUMENT 00 2113**

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# AIA<sup>®</sup> Document A701<sup>™</sup> – 2018

## Instructions to Bidders

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

New Building For Palmyra United Methodist Church  
Business Highway 61 South, Palmyra, Missouri

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

Palmyra United Methodist Church  
110 W. Olive Street  
Palmyra, MO 63431

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

Architechnics, Inc  
510 Maine - 10th Floor  
Quincy, IL 62301

### 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 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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

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

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612<sup>™</sup>-2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

## 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 any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

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

§ 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, to which Work may be added or deleted by 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, or that does not change, 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 By submitting a Bid, the Bidder represents that:

- .1 the Bidder has read and understands the Bidding Documents;
- .2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
- .3 the Bid complies with the Bidding Documents;
- .4 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 observations with the requirements of the Proposed Contract Documents;
- .5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- .6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

## ARTICLE 3 BIDDING DOCUMENTS

### § 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

*(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)*

Refer to Invitation to Bid

**§ 3.1.2** Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

**§ 3.1.3** 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.

**§ 3.1.4** Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

**§ 3.1.5** The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

### **§ 3.2 Modification or Interpretation of Bidding Documents**

**§ 3.2.1** The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

**§ 3.2.2** Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids.  
*(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)*

In writing, email is acceptable

**§ 3.2.3** Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall 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 Substitution Process**

**§ 3.3.2.1** Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

**§ 3.3.2.2** Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

**§ 3.3.2.3** If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

**§ 3.3.3** 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.

**§ 3.3.4** If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 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 Bidders known by the issuing office to have received complete Bidding Documents.

*(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)*

Electronically

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 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 Prior to submitting a Bid, each Bidder shall ascertain 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 or identified in the Bidding Documents.

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

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms 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” or as required by the bid form.

§ 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 neither make 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 and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name 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.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

#### § 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security:

*(Insert the form and amount of bid security.)*

Refer to Invitation to Bid

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, 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. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

**§ 4.2.3** If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

**§ 4.2.4** The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning Refer to Supplementary Instructions to Bidders days after the opening of Bids, withdraw its Bid and request the return of its bid security.

### **§ 4.3 Submission of Bids**

**§ 4.3.1** A Bidder shall submit its Bid as indicated below:

*(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)*

Form bound in project manual

**§ 4.3.2** Paper copies of the Bid, the bid security, 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.

**§ 4.3.3** Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

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

**§ 4.3.5** A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

### **§ 4.4 Modification or Withdrawal of Bid**

**§ 4.4.1** Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

**§ 4.4.2** Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

**§ 4.4.3** After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:  
*(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)*

Refer to Supplementary Instructions to Bidders

## **ARTICLE 5 CONSIDERATION OF BIDS**

### **§ 5.1 Opening of Bids**

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

### **§ 5.2 Rejection of Bids**

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

### **§ 5.3 Acceptance of Bid (Award)**

**§ 5.3.1** It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, 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 best interests.

**§ 5.3.2** Unless otherwise prohibited by law, 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 lowest responsive and responsible 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 and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

### **§ 6.2 Owner's Financial Capability**

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

### **§ 6.3 Submittals**

**§ 6.3.1** After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; 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 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, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for 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.

§ 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 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

*(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)*

### § 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 commence sooner 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.

§ 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 to the bond a certified and current copy of the power of attorney.

## ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

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

**.5 Drawings**

<b>Number</b>	<b>Title</b>	<b>Date</b>
Refer to Drawings Index		

**.6 Specifications**

<b>Section</b>	<b>Title</b>	<b>Date</b>	<b>Pages</b>
Refer to Specifications Table of Contents			

**.7 Addenda:**

<b>Number</b>	<b>Date</b>	<b>Pages</b>
TBD		

**.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.)*

The Sustainability Plan:

<b>Title</b>	<b>Date</b>	<b>Pages</b>
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Supplementary and other Conditions of the Contract:

<b>Document</b>	<b>Title</b>	<b>Date</b>	<b>Pages</b>
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**.9 Other documents listed below:**

*(List here any additional documents that are intended to form part of the Proposed Contract Documents.)*

# **Additions and Deletions Report for** **AIA® Document A701™ – 2018**

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 09:03:55 ET on 05/16/2019.

## **PAGE 1**

New Building For Palmyra United Methodist Church  
Business Highway 61 South, Palmyra, Missouri

...

Palmyra United Methodist Church  
110 W. Olive Street  
Palmyra, MO 63431

...

Architechnics, Inc  
510 Maine - 10th Floor  
Quincy, IL 62301

## **PAGE 2**

Refer to Invitation to Bid

## **PAGE 3**

In writing, email is acceptable

## **PAGE 4**

Electronically

...

Refer to Invitation to Bid

## **PAGE 5**

**§ 4.2.4** The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been

awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning Refer to Supplementary Instructions to Bidders days after the opening of Bids, withdraw its Bid and request the return of its bid security.

...

Form bound in project manual

...

Refer to Supplementary Instructions to Bidders

**PAGE 8**

Refer to Drawings Index

...

Refer to Specifications Table of Contents

...

TBD

## **Certification of Document's Authenticity**

**AIA® Document D401™ – 2003**

I, Todd J. Moore, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 09:03:55 ET on 05/16/2019 under Order No. 3902184019 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A701™ - 2018, Instructions to Bidders, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

---

*(Signed)*

---

*(Title)*

---

*(Dated)*

**DOCUMENT 00 2213**  
**SUPPLEMENTARY INSTRUCTIONS TO BIDDERS**

**1.1 INSTRUCTIONS TO BIDDERS**

- A. Instructions to Bidders for Project consist of the following:
1. AIA Document A701, "Instructions to Bidders," a copy of which is bound in this Project Manual.
  2. The following Supplementary Instructions to Bidders that modify and add to the requirements of the Instructions to Bidders.

**1.2 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL**

- A. The following supplements modify AIA Document A701, "Instructions to Bidders." Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of the Instructions to Bidders shall remain in effect.

**1.3 ARTICLE 2 - BIDDER'S REPRESENTATIONS**

- A. Add Section 2.1.3.1:
1. 2.1.3.1 - The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.
- B. Add Section 2.1.5:
1. 2.1.5 - The Bidder is a properly licensed Contractor according to the laws and regulations of City of Palmyra and meets qualifications indicated in the Procurement and Contracting Documents.
- C. Add Section 2.1.6:
1. 2.1.6 - The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

**1.4 ARTICLE 3 - BIDDING DOCUMENTS**

- A. 3.2 - Interpretation or Correction of Procurement and Contracting Documents:
1. Add Section 3.2.2.1:
    - a. 3.2.2.1 - Submit Bidder's Requests for Interpretation using form bound in the Project Manual.
- B. 3.4 - Addenda:
1. Delete Section 3.4.3 and replace with the following:

- a. 3.4.3 - Addenda may be issued at any time prior to the receipt of bids.
- 2. Add Section 3.4.4.1:
  - a. 3.4.4.1 - Owner may elect to waive the requirement for acknowledging receipt of 3.4.4 Addenda as follows:
    - 1) 3.4.4.1.1 - Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.
    - 2) 3.4.4.1.2 - Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.

## **1.5 ARTICLE 4 - BIDDING PROCEDURES**

- A. 4.1 - Preparation of Bids:
  - 1. Add Section 4.1.1.1:
    - a. 4.1.1.1 - Printable electronic Bid Forms and related documents are available from Architect.
  - 2. Add Section 4.1.8:
    - a. 4.1.8 - The Bid shall include unit prices when called for by the Procurement and Contracting Documents. Owner may elect to consider unit prices in the determination of award. Unit prices will be incorporated into the Contract.
  - 3. Add Section 4.1.9:
    - a. 4.1.9 - Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.
- B. 4.4 - Modification or Withdrawal of Bids:
  - 1. Add the following sections to 4.4.2:
    - a. 4.4.2.1 - Such modifications to or withdrawal of a bid may only be made by persons authorized to act on behalf of the Bidder. Authorized persons are those so identified in the Bidder's corporate bylaws, specifically empowered by the Bidder's charter or similar legally binding document acceptable to Owner, or by a power of attorney, signed and dated, describing the scope and limitations of the power of attorney. Make such documentation available to Owner at the time of seeking modifications or withdrawal of the Bid.
    - b. 4.4.2.2 - Owner will consider modifications to a bid written on the sealed bid envelope by authorized persons when such modifications comply with the following: the modification is indicated by a percent or stated amount to be added to or deducted from the Bid; the amount of the Bid itself is not made known by the modification; a signature of the authorized person, along with the time and date of the modification, accompanies the modification. Completion of an unsealed bid form, awaiting final figures from the Bidder, does not require power of attorney due

to the evidenced authorization of the Bidder implied by the circumstance of the completion and delivery of the Bid.

**1.6 ARTICLE 5 - CONSIDERATION OF BIDS**

A. 5.2 - Rejection of Bids:

1. Add Section 5.2.1:

- a. 5.2.1 - Owner reserves the right to reject a bid based on Owner's and Architect's evaluation of qualification information submitted following opening of bids. Owner's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

**1.7 ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND**

A. 7.1 - Bond Requirements:

1. Add Section 7.1.1.1:

- a. 7.1.1.1 - Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.

B. 7.2 - Time of Delivery and Form of Bonds:

1. Delete the first sentence of Section 7.2.1 and insert the following:

- a. The Bidder shall deliver the required bonds to Owner no later than 10 days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

2. Delete Section 7.2.3 and insert the following:

- a. 7.2.3 - Bonds shall be executed and be in force on the date of the execution of the Contract.

**1.8 ARTICLE 8 - FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR**

- A. AIA A101 Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

**1.9 ARTICLE 9 - EXECUTION OF THE CONTRACT**

- A. Add Article 9:

1. 9.1.1 - Subsequent to the Notice of Intent to Award, and within 10 days after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee shall execute and deliver the Agreement to Owner through Architect, in such number of counterparts as Owner may require.
2. 9.1.2 - Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds when the Agreement is presented for signature within the period of time allowed.
3. 9.1.3 - Unless otherwise indicated in the Procurement and Contracting Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement.
4. 9.1.4 - In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-advertise for bids.

**END OF DOCUMENT 00 2213**

**DOCUMENT 00 2513  
PREBID MEETINGS**

**1.1 PREBID MEETING**

- A. Architect will conduct a Prebid meeting as indicated below:
  - 1. Meeting Date: May 29, 2019.
  - 2. Meeting Time: 9:00 am, local time.
  - 3. Location: Palmyra United Methodist Church, 110 West Olive St, Palmyra, MO 63461.
  
- B. Attendance:
  - 1. Prime Bidders: Attendance at Prebid meeting is recommended.
  - 2. Subcontractors: Attendance at Prebid meeting is recommended.
  
- C. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:
  - 1. Procurement and Contracting Requirements:
    - a. Advertisement for Bids.
    - b. Instructions to Bidders.
    - c. Bonding.
    - d. Insurance.
    - e. Bid Security.
    - f. Bid Form and Attachments.
    - g. Bid Submittal Requirements.
  
  - 2. Communication during Bidding Period:
    - a. Obtaining documents.
    - b. Bidder's Requests for Information.
    - c. Bidder's Substitution Request/Prior Approval Request.
    - d. Addenda.
  
  - 3. Contracting Requirements:
    - a. Agreement.
    - b. The General Conditions.
    - c. The Supplementary Conditions.
  
  - 4. Construction Documents:
    - a. Scopes of Work.
    - b. Temporary Facilities.
    - c. Use of Site.
    - d. Work Restrictions.
    - e. Alternates, Allowances, and Unit Prices.
    - f. Substitutions following award.
  
  - 5. Separate Contracts:
    - a. Work by Owner.

- b. Work of Other Contracts.
6. Schedule:
- a. Project Schedule.
  - b. Contract Time.
  - c. Liquidated Damages.
  - d. Other Bidder Questions.
7. Site/facility visit or walkthrough.
8. Post-Meeting Addendum.
- D. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees. Minutes of meeting are issued as Available Information and do not constitute a modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.
- 1. Sign-in Sheet: Minutes will include list of meeting attendees.
  - 2. List of Planholders: Minutes will include list of planholders.

**END OF DOCUMENT 00 2513**

**DOCUMENT 00 2600**  
**PROCUREMENT SUBSTITUTION PROCEDURES**

**1.1 DEFINITIONS**

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 2500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

**1.2 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.

**1.3 PROCUREMENT SUBSTITUTIONS**

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
  - 1. Extensive revisions to the Contract Documents are not required.
  - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
  - 3. The request is fully documented and properly submitted.

**1.4 SUBMITTALS**

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:
  - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
  - 2. Submittal Format: Submit one copies of each written Procurement Substitution Request, using form bound in Project Manual.
- B. Architect's Action:
  - 1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of

the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

**END OF DOCUMENT 00 2600**

**DOCUMENT 00 4113**  
**BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)**

**1.1 BID INFORMATION**

- A. Bidder: \_\_\_\_\_.
- B. Project Name: Site Prep, Structural Building Shell Bid Package with Minor MEP Infrastructure Systems.
- C. Project Location: Palmyra, Missouri.
- D. Owner: Palmyra United Methodist Church.
- E. Architect: Architechnics Inc.
- F. Architect Project Number: 5356.

**1.2 CERTIFICATIONS AND BASE BID**

- A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by Architechnics and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).
  - 2. The above amount may be modified by amounts indicated by the Bidder on the attached Document 004322 "Unit Prices Form" and Document 004323 "Alternates Form."

**1.3 ALTERNATE BIDS**

- A. Alternate Bid 01: Roof
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).
- B. Alternate Bid 02:
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).
- C. Alternate Bid 03: Masonry
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).
- D. Alternate Bid 04: Clerestory Windows
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).
- E. Alternate Bid 05: Steeple

1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).

F. Alternate Bid 06: Covered Drop-Off

1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).

#### 1.4 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. \_\_\_\_\_ Dollars  
(\$\_\_\_\_\_).

B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

#### 1.5 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated \_\_\_\_\_.
2. Addendum No. 2, dated \_\_\_\_\_.
3. Addendum No. 3, dated \_\_\_\_\_.
4. Addendum No. 4, dated \_\_\_\_\_.

#### 1.6 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Form Supplement - Alternates.

#### 1.7 SUBMISSION OF BID

A. Respectfully submitted this \_\_\_\_ day of \_\_\_\_\_, 2019.

B. Submitted By: \_\_\_\_\_ (Name of bidding firm or corporation).

C. Authorized Signature: \_\_\_\_\_ (Handwritten signature).

D. Title: \_\_\_\_\_ (Owner/Partner/President/Vice President).

E. Street Address: \_\_\_\_\_.

F. City, State, Zip: \_\_\_\_\_.

G. Phone: \_\_\_\_\_.

**END OF DOCUMENT 00 4113**

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**DOCUMENT 00 4313  
BID SECURITY FORMS**

**1.1 BID FORM SUPPLEMENT**

- A. A completed bid bond form is required to be attached to the Bid Form.

**1.2 BID BOND FORM**

- A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. Copies of AIA standard forms may be obtained from The American Institute of Architects; <https://www.aiacontracts.org/>; email: [docspurchases@aia.org](mailto:docspurchases@aia.org); (800) 942-7732.

**END OF DOCUMENT 00 4313**

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**SECTION 01 1000  
SUMMARY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Purchase contracts.
8. Owner-furnished products.
9. Contractor-furnished, Owner-installed products.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and Drawing conventions.
14. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

**1.2 PROJECT INFORMATION**

A. Project Identification: Site Prep and Building Shell Package with minor MEP Infrastructure.

1. Project Location: Business Highway 61, Palmyra, MO 63459.

B. Owner: Palmyra United Methodist Church.

1. Owner's Representative: Doug Aeilts.

C. Architect: Architechnics, Inc; 510 Maine, 10th Floor Quincy, Illinois 62301; 217-222-0554.

**1.3 WORK COVERED BY CONTRACT DOCUMENTS**

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Unfinished pre-engineered metal building with partial basement, partial MEP infrastructure and minor site work and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

#### **1.4 ACCESS TO SITE**

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

#### **1.5 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION (Not Used)**

#### **END OF SECTION 01 1000**

**SECTION 01 2300  
ALTERNATES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for alternates.

**1.2 DEFINITIONS**

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

**1.3 PROCEDURES**

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 SCHEDULE OF ALTERNATES**

- A. Alternate No. 01: Roof.
  - 1. Base Bid: Exposed fastener metal panel as specified in Section 13 3419 Metal Building Systems.

2. Alternate: Standing seam metal panel as specified in Section 13 3419 Metal Building Systems.
- B. Alternate No. 02: Exterior Wall Cladding
1. Base Bid: Single skin metal panel with exposed fasteners as specified in section 13 3419 Metal Building Systems.
  2. Alternate Bid: Insulated metal panel system as specified in section 13 3419 Metal Building Systems.
- C. Alternate Bid 03: Masonry
1. Base Bid: Full height masonry on east elevation as indicated on drawings.
  2. Alternate Bid: Masonry as indicated on drawings up to and including cast stone sill then replace masonry with metal panel above cast stone sill. Panel shall be single skin metal panel.
- D. Alternate Bid 04: Clerestory Windows
1. Base Bid: Provide clerestory windows as indicated on the drawings.
  2. Alternate Bid: Omit clerestory windows as indicated on the drawings.
- E. Alternate Bid 05: Steeple
1. Base Bid: Provide the steeple and framing as indicated on the drawings.
  2. Alternate Bid: Omit the steeple but install the framing for future steeple installation.
- F. Alternate Bid 06: Covered Drop-Off
1. Base Bid: Install the covered drop-off as indicated on the drawings.
  2. Alternate Bid: Omit the covered drop-off and install roofing, eave trim and ceiling under porch normally in its place.

**END OF SECTION 01 2300**

**SECTION 01 2500  
SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 01 2300 "Alternates" for products selected under an alternate.

**1.2 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

**1.3 ACTION SUBMITTALS**

- A. Substitution Requests: Submit one copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use facsimile of form provided in Project Manual.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### **1.4 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.

#### **1.5 PROCEDURES**

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

#### **1.6 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 01 2500**

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**SECTION 01 2600  
CONTRACT MODIFICATION PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

**1.2 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.

**1.3 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 or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - 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.

**1.4 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.

**1.5 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.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 2600**

**SECTION 01 2900  
PAYMENT PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

**1.2 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.

**1.3 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. Name of Architect.
    - c. Architect's Project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Arrange schedule of values consistent with format of AIA Document G703.
  - 3. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 4. 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.

#### 1.4 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: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of 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.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- 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. 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.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 2900**

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**SECTION 01 3100  
PROJECT MANAGEMENT AND COORDINATION**

**PART 1 - GENERAL**

**1.1 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. 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 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 2. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.

**1.2 DEFINITIONS**

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

**1.3 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 and 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.

#### 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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.

#### 1.5 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. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  2. 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.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
  3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
  4. 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. Digital Data Software Program: Drawings are available in Autocad Revit.
    - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

## 1.6 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 so as 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. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.

7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. 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 seven working 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 01 2600 "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 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.

8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

## **1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES**

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and CAD drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
  2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. The following digital data files will be furnished for each appropriate discipline:
    - a. Floor plans.
    - b. Reflected ceiling plans.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
  3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

## **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 10 working 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: 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. Sustainable design requirements.
    - o. Preparation of Record Documents.
    - p. Use of the premises and existing building.
    - q. Work restrictions.
    - r. Working hours.
    - s. Owner's occupancy requirements.
    - t. Responsibility for temporary facilities and controls.
    - u. Procedures for moisture and mold control.
    - v. Procedures for disruptions and shutdowns.
    - w. Construction waste management and recycling.
    - x. Parking availability.
    - y. Office, work, and storage areas.
    - z. Equipment deliveries and priorities.
    - aa. First aid.
    - bb. Security.
    - cc. Progress cleaning.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: Conduct progress meetings at regular 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.
  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) Status of sustainable design documentation.
  - 6) Deliveries.
  - 7) Off-site fabrication.
  - 8) Access.
  - 9) Site use.
  - 10) Temporary facilities and controls.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) Status of RFIs.
  - 16) Status of Proposal Requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. 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.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 3100**

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**SECTION 01 3300  
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 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 7700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
3. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
5. Section 01 7900 "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 FORMATS**

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of firm or entity that prepared submittal.
5. Names of subcontractor, manufacturer, and supplier.
6. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
7. Category and type of submittal.
8. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
9. Drawing number and detail references, as appropriate.

10. Indication of full or partial submittal.
11. 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. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

#### **1.4 SUBMITTAL PROCEDURES**

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
    - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- 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.

- 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. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. 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.

### 1.5 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 product specifications.
    - b. Standard color charts.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrent 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Notation of dimensions established by field measurement.
    - c. Relationship and attachment to adjoining construction clearly indicated.
- C. Samples: Submit Samples for review of kind, 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. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
  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.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  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(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- D. 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.
- E. 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.

## **1.6 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.

#### **1.7 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.

#### **1.8 ARCHITECT'S REVIEW**

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  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 01 3300**

**SECTION 01 4000  
QUALITY REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 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.
  - 4. Specific test and inspection requirements are not specified in this Section.

**1.2 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: 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 trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. 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.
- E. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

- F. 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.
- G. 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.

### **1.3 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.

### **1.4 CONFLICTING REQUIREMENTS**

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### **1.5 ACTION SUBMITTALS**

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

### **1.6 INFORMATIONAL SUBMITTALS**

- A. Reports: Prepare and submit certified written reports and documents as specified.
- B. 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 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 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 whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

- A. General: 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 are similar in material, design, and extent to those indicated for this Project.
- F. **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.
- G. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

## **1.9 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. 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. **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.
- C. **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.
- D. **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 01 3300 "Submittal Procedures."
- E. **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.
- F. **Associated Contractor 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.
- G. **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.

#### **1.10 SPECIAL TESTS AND INSPECTIONS**

- A. **Special Tests and Inspections:** Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, 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 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 01 7300 "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 01 4000**

**SECTION 01 5000  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

**1.2 USE CHARGES**

- A. General: Installation and removal of 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 Service: Pay water-service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

**1.3 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. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

**1.4 QUALITY ASSURANCE**

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

**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 MATERIALS**

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

### **2.2 TEMPORARY FACILITIES**

- A. Common-Use Field Office: 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. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
  - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 4. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

### **2.3 EQUIPMENT**

- A. 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 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.

## **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.
  1. Locate facilities to limit site disturbance as specified in Section 01 1000 "Summary."
- 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.

### **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: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  1. Connect temporary service to Owner's existing power source, as directed by Owner.
- D. 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.

### **3.4 SUPPORT FACILITIES INSTALLATION**

- A. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
  1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- B. Parking: Provide temporary parking areas for construction personnel.
- C. 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.

### **3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. 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 erosion- and sedimentation-control Drawings.
  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.
- C. 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.
- D. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

### **3.6 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 01 7700 "Closeout Procedures."

**END OF SECTION 01 5000**

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**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 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 01 2300 "Alternates" for products selected under an alternate.
  - 2. Section 01 2500 "Substitution Procedures" for requests for substitutions.

**1.2 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. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. 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. 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, if applicable.

### 1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Architect's Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
    - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 3300 "Submittal Procedures." Show compliance with requirements.

### 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.
- 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-connected 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 identification requirements.

## 1.5 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 to determine that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 6. Protect stored products from damage and liquids from freezing.
  - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.6 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 7700 "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.
- B. Product Selection Procedures:
1. 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, which 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: ..."
  2. 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, which 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: ..."
  3. 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 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 01 2500 "Substitution Procedures" for substitutions for convenience.

### **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 these 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. Detailed comparison of significant qualities of proposed product with those named in the Specifications. 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.
  2. Evidence that proposed product provides specified warranty.
  3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  4. Samples, if requested.
- B. Submittal Requirements: 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.

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 6000**

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**SECTION 01 7700  
CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

**1.1 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.
  - 5. Repair of the Work.
  
- B. Related Requirements:
  - 1. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 2. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Section 01 7900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

**1.2 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.

**1.3 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. 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 01 7900 "Demonstration and Training."
  - 6. Advise Owner of changeover in utility services.

7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.

#### **1.4 FINAL COMPLETION PROCEDURES**

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 01 2900 "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. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect 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.

#### **1.5 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 site 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 on digital media acceptable to Architect.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 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 FINAL CLEANING**

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.

- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.
- D. 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 before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

**END OF SECTION 01 7700**

**SECTION 01 7823  
OPERATION AND MAINTENANCE DATA**

**PART 1 - GENERAL**

**1.1 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 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

**1.2 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.

**1.3 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. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. 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.

- D. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### **1.4 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.

#### **1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## **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. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. 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. 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.
- I. 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 01 7823**

**SECTION 01 7839  
PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
- B. Related Requirements:
  - 1. Section 01 7300 "Execution" for final property survey.
  - 2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
  - 3. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.2 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

**1.3 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 sets 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.

#### **1.4 RECORD SPECIFICATIONS**

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  5. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy.

#### **1.5 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**

**PART 3 - EXECUTION**

**END OF SECTION 01 7839**

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**SECTION 01 7900  
DEMONSTRATION AND TRAINING**

**PART 1 - GENERAL**

**1.1 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.

**1.2 QUALITY ASSURANCE**

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.

**1.3 COORDINATION**

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

**1.4 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. 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.
2. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.
    - d. Economy and efficiency adjustments.
  3. Troubleshooting: Include the following:
    - a. Diagnostic instructions.
    - b. Test and inspection procedures.
  4. 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.
  5. 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.

## 1.5 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 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

**1.6 INSTRUCTION**

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: 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.
- D. 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.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

**PART 2 - PRODUCTS**

**PART 3 - EXECUTION**

**END OF SECTION 01 7900**

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**SECTION 03 1000  
CONCRETE FORMING AND ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Form-facing material for cast-in-place concrete.
- B. Related Requirements:
  - 1. Section 32 1313 "Concrete Paving" for formwork related to concrete pavement and walks.

**1.2 DEFINITIONS**

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Void forms.
  - 2. Waterstops.
  - 3. Form-release agent.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

**PART 2 - PRODUCTS**

**2.1 FORM-FACING MATERIALS**

- A. As-Cast Surface Form-Facing Material:
  - 1. Provide continuous, true, and smooth concrete surfaces.
  - 2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 3000 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
  1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

## 2.2 WATERSTOPS

- A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  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. BoMetals, Inc.
    - b. Sika Corporation.
    - c. Vinylex Waterstop & Accessories.
  2. Profile: Flat dumbbell with center bulb Ribbed with center bulb.
  3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
  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. Carlisle Coatings & Waterproofing Inc.
    - b. CETCO, a Minerals Technologies company.
    - c. JP Specialties, Inc.
    - d. Sika Corporation.

## 2.3 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF FORMWORK**

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 3000 "Cast-In-Place Concrete" for as-cast finishes
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
  - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.

- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
  - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
  - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 3. Place joints perpendicular to main reinforcement.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
  - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### **3.2 INSTALLATION OF EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.

5. Clean embedded items immediate prior to concrete placement.

### **3.3 INSTALLATION OF WATERSTOPS**

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
  1. Install in longest lengths practicable.
  2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 03 3000 "Cast-In-Place Concrete."
  4. Secure waterstops in correct position at 12 inches on center.
  5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
    - a. Miter corners, intersections, and directional changes in waterstops.
    - b. Align center bulbs.
  6. Clean waterstops immediately prior to placement of concrete.
  7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
  1. Install in longest lengths practicable.
  2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  3. Protect exposed waterstops during progress of the Work.

### **3.4 REMOVING AND REUSING FORMS**

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work.
  1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  1. Align and secure joints to avoid offsets.
  2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### **3.5 SHORING AND RESHORING INSTALLATION**

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

**3.6 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

**END OF SECTION 03 1000**

**SECTION 03 2000  
CONCRETE REINFORCING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Steel reinforcement bars.
  - 2. Welded-wire reinforcement.
- B. Related Requirements:
  - 1. Section 32 1313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Each type of steel reinforcement.
  - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
  - 1. Include placing drawings that detail fabrication, bending, and placement.
  - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
  - 1. Location of construction joints is subject to approval of the Architect.

**1.3 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - 1. Store reinforcement to avoid contact with earth.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn 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. 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 zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
    - d. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
  - 1. Finish: Plain.

### **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 shall 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).
- 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 shall not exceed 12 inches (305 mm).
  - 2. Lap edges and ends of adjoining sheets at least one mesh 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.
- 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 and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. Steel-reinforcement placement.

**END OF SECTION 03 2000**

**SECTION 03 3000  
CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
  - 1. Section 03 1000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
  - 2. Section 03 2000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
  - 3. Section 32 1313 "Concrete Paving" for concrete pavement and walks.

**1.2 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For the following:
  - 1. Installer: Include copies of applicable ACI certificates.
  - 2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Curing compounds.
  - 4. Floor and slab treatments.
  - 5. Bonding agents.
  - 6. Adhesives.
  - 7. Vapor retarders.
  - 8. Semirigid joint filler.
  - 9. Joint-filler strips.
  - 10. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Portland cement.

2. Fly ash.
3. Aggregates.

#### **1.4 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."

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with ASTM C94/C94M and ACI 301.

#### **1.6 FIELD CONDITIONS**

- A. Cold-Weather Placement: Comply with ACI 301 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 for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 .
  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 , 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 and ACI 305.1 , and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F .
  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 the following unless modified by requirements in the Contract Documents:
1. ACI 301 .

#### **2.2 CONCRETE MATERIALS**

- A. Source Limitations:

1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
  2. Obtain aggregate from single source.
  3. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
  2. Fly Ash: ASTM C618, Class C or F.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1 inch 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 in steel-reinforced concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  2. Retarding Admixture: ASTM C494/C494M, Type B.
  3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

## 2.3 FIBER REINFORCEMENT

- A. Synthetic Monofilament Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
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. BASF Corporation.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. FiberForce; ABC Polymer Industries, LLC.
    - d. Sika Corporation.
- B. Synthetic Fibrillated Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.
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. BASF Corporation.
- b. Euclid Chemical Company (The); an RPM company.
- c. FiberForce; ABC Polymer Industries, LLC.
- d. Sika Corporation.

## 2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  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. Barrier-Bac; Inteplast Group, Ltd.
    - b. Stego Industries, LLC.
    - c. W.R. Meadows, Inc.

## 2.5 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  1. Color:
    - a. Ambient Temperature Below 50 deg F : Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F : Any color.
    - c. Ambient Temperature Above 85 deg F : White.
- B. Water: Potable or complying with ASTM C1602/C1602M.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.7 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch 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 or coarse sand, as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi 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 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 or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.8 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.
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.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, and concrete with a w/cm below 0.50.

## 2.9 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.

1. Exposure Class: ACI 318 F2 S0 W0 C1.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm: 0.45.
  4. Slump Limit: 5 inches , plus or minus 1 inch 8 inches , plus or minus 1 inch for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
  5. Air Content:
    - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- B. Class B: Normal-weight concrete used for foundation walls.
1. Exposure Class: ACI 318 F2 S0 W0 C1.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm: 0.45.
  4. Slump Limit: 5 inches , plus or minus 1 inch.
  5. Air Content:
    - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318F0 S0 W0 C0.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm: 0.45.
  4. Minimum Cementitious Materials Content: 520 lb/cu. yd..
  5. Slump Limit: 4 inches , plus or minus 1 inch.
  6. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 0.15 percent by weight of cement.
  8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd..
- D. Class D: Normal-weight concrete used for interior suspended slabs.
1. Exposure Class: ACI 318F0 S0 W0 C0.
  2. Minimum Compressive Strength: 4000 psi at 28 days.
  3. Maximum w/cm: 0.45.
  4. Minimum Cementitious Materials Content: 520 lb/cu. yd..
  5. Slump Limit: 4 inches , plus or minus 1 inch.
  6. Air Content:

- a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd..

## **2.10 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

## **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 INSTALLATION OF EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### **3.3 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 , sealing vapor retarder to concrete.
  4. Lap joints 6 inches 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 on all sides, and sealing to vapor retarder.

### **3.4 JOINTS**

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
  1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

### **3.5 CONCRETE PLACEMENT**

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 , but not to exceed the amount indicated on the concrete delivery ticket.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  - 1. If a section cannot be placed continuously, provide construction joints as indicated.
  - 2. Deposit concrete to avoid segregation.
  - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 .
    - 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 into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Do not place concrete floors and slabs in a checkerboard sequence.
  - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 3. Maintain reinforcement in position on chairs during concrete placement.
  - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 5. Level concrete, cut high areas, and fill low areas.
  - 6. Slope surfaces uniformly to drains where required.
  - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  - 8. Do not further disturb slab surfaces before starting finishing operations.

### **3.6 FINISHING FORMED SURFACES**

- A. As-Cast Surface Finishes:
  - 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch .
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
- a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch .
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

### 3.7 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. Float Finish:
1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
  2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
  3. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
  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 and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch 3/16 inch 1/8 inch.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
  2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete 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.

### **3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS**

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches 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: 3000 psi at 28 days.
  4. 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 concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

### **3.9 CONCRETE CURING**

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
  - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 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 .
      - 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 , 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.
  - b. Floors to Receive Curing Compound:
    - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
    - 3) Maintain continuity of coating, and repair damage during curing period.

- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

c. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### **3.10 TOLERANCES**

- A. Conform to ACI 117.

### **3.11 JOINT FILLING**

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s).
  2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### **3.12 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 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 in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch .
    - 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 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 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 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 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 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.

### **3.13 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- 1. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports shall include reporting requirements of ASTM C31/C31M and ASTM C39/C39M, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.

- 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
  - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Curing procedures and maintenance of curing temperature.
  5. Verification of concrete strength before removal of shores and forms from beams and slabs.
  6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. , but less than 25 cu. yd. , plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. 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 and below or 80 deg F 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 four 6-inch by 12-inch 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. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  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 if specified compressive strength is 5000 psi , or no compressive strength test value is less than 1 percent of specified compressive strength if specified compressive strength is greater than 5000 psi .
  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 shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
      - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 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 within 72 hours of completion of floor finishing and promptly report test results to Architect.

### **3.14 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.

**END OF SECTION 03 3000**

**SECTION 04 2000  
UNIT MASONRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Clay face brick.
  - 2. Mortar and grout.
  - 3. Steel reinforcing bars.
  - 4. Masonry-joint reinforcement.
  - 5. Ties and anchors.
  - 6. Embedded flashing.
  
- B. Products Installed but not Furnished under This Section:
  - 1. Steel shelf angles for supporting unit masonry.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  
- B. Samples for Initial Selection:
  - 1. Concrete face brick, in the form of small-scale units.
  - 2. Clay face brick, in the form of straps of five or more bricks.
  - 3. Weep holes/cavity vents.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
  
- B. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
  
- C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

#### 1.4 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.

#### 1.5 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 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 down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### **2.2 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 and will be within 20 feet vertically and horizontally of a walking surface.
- 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 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.
  - 1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C67.

2. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
3. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet or shall have a history of successful use in Project's area.
4. Size (Actual Dimensions): 3-1/2 inches wide by 2-1/4 inches high by 7-1/2 inches long or 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Application: Use where brick is exposed unless otherwise indicated.
6. Color and Texture: As selected by Architect.

## **2.4 MORTAR AND GROUT MATERIALS**

- A. Masonry Cement: ASTM C91/C91M.
- B. Water: Potable.

## **2.5 REINFORCEMENT**

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 .
- 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 steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

## **2.6 TIES AND ANCHORS**

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
  2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
  3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.030-inch-thick steel sheet, galvanized after fabrication.

## **2.7 EMBEDDED FLASHING MATERIALS**

- A. Flexible Flashing: Use one of the following unless otherwise indicated:
  1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.

- B. Application: Unless otherwise indicated, use the following:
  - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
  - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
  - 4. Where flashing is fully concealed, use flexible flashing.
- C. 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.
- D. Termination Bars for Flexible Flashing: Aluminum Stainless steel bars 0.075 inch by 1 inch.

## **2.8 MASONRY CLEANERS**

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

## **2.9 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 masonry cement mortar unless otherwise indicated.
  - 3. 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.

## **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. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

### **3.3 TOLERANCES**

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch .
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch .
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet , or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet , 1/4 inch in 20 feet , or 1/2-inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet , 3/8 inch in 20 feet , or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet , 1/4 inch in 20 feet , or 1/2-inch maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet , 3/8 inch in 20 feet , or 1/2-inch maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch , with a maximum thickness limited to 1/2 inch .
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch .
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch .
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch .
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. 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.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.6 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.

### 3.7 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### 3.8 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches ; with upper edge tucked under water-resistive barrier, lapping at least 4 inches . Fasten upper edge of flexible flashing to sheathing through termination bar.
  - 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  - 8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
  - 1. Use specified weep/cavity vent products to form weep holes.
  - 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  - 3. Space weep holes 24 inches o.c. unless otherwise indicated.
  - 4. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
  - 5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
  - 6. Trim wicking material flush with outside face of wall after mortar has set.
- F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
  - 1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches above top of pea gravel.
- G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
  - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### **3.9 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 cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

### **3.10 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 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 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 04 2000**

**SECTION 04 7200  
CAST STONE MASONRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Cast-stone trim
- B. Related Sections:
  - 1. Section 04 2000 "Unit Masonry" for installing cast-stone units in unit masonry.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. For cast-stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
  - 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples for Verification:
  - 1. For each color and texture of cast stone required, 10 inches square in size.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.
  - 1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
  - 1. Provide test reports based on testing within previous two years.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast-stone units in suitable packs or pallets.
  - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast-stone units if required, using dollies with wood supports.
  - 2. Store cast-stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Cast Stone: Obtain cast-stone units from single source from single manufacturer.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

### 2.2 CAST-STONE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast-stone color indicated.
- B. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33/C 33M, gradation and colors as needed to produce required cast-stone textures and colors.
- C. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast-stone material.
  - 1. Epoxy Coating: ASTM A 775/A 775M.
  - 2. Galvanized Coating: ASTM A 767/A 767M.
- D. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304 steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.

### 2.3 CAST-STONE UNITS

- A. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.

3. Provide drips on projecting elements unless otherwise indicated.

B. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

C. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.

D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

E. Colors and Textures: Match Architect's samples.

## **2.4 ACCESSORIES**

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666 steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.
- B. Dowels: 1/2-inch- diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666 steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.

## **2.5 MORTAR MIXES**

- A. Comply with requirements in Section 04 2000 "Unit Masonry" for mortar mixes.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 SETTING CAST STONE IN MORTAR**

- A. Install cast-stone units to comply with requirements in Section 04 2000 "Unit Masonry."

- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
  - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.
  - 2. Build anchors and ties into mortar joints as units are set.
  - 3. Fill dowel holes and anchor slots with mortar.
  - 4. Fill collar joints solid as units are set.
  - 5. Build concealed flashing into mortar joints as units are set.
  - 6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
  - 7. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- H. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.
- I. Point joints with sealant to comply with applicable requirements in Section 07 9200 "Joint Sealants."
  - 1. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- J. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
  - 1. Keep joints free of mortar and other rigid materials.
  - 2. Build in compressible foam-plastic joint fillers where indicated.
  - 3. Form joint of width indicated, but not less than 3/8 inch.
  - 4. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
  - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 9200 "Joint Sealants."

### **3.3 INSTALLATION TOLERANCES**

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

### **3.4 ADJUSTING AND CLEANING**

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
  - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

**END OF SECTION 04 7200**

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**SECTION 05 1200  
STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel.
  - 2. Shear stud connectors.
  - 3. Shrinkage-resistant grout.
  
- B. Related Requirements:
  - 1. Section 13 3419 "Metal Building Systems" for structural steel.

**1.2 DEFINITIONS**

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

**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 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Structural-steel materials.
  - 2. High-strength, bolt-nut-washer assemblies.
  - 3. Shear stud connectors.
  - 4. 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.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Mill test reports for structural-steel materials, including chemical and physical properties.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 341.
  - 3. ANSI/AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Construction: Moment frame.

### **2.2 STRUCTURAL-STEEL MATERIALS**

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles-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. Welding Electrodes: Comply with AWS requirements.

### **2.3 BOLTS AND CONNECTORS**

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

### **2.4 RODS**

- A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
  - 1. Nuts: ASTM A563 heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 4. Finish: Plain.

### **2.5 PRIMER**

- A. Steel Primer:
  - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

### **2.6 SHRINKAGE-RESISTANT GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

### **2.7 FABRICATION**

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. 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. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
- E. 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.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## **2.8 SHOP CONNECTIONS**

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: 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.

## **2.9 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.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. 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 2.

## **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.
1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

### **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.
  - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

**END OF SECTION 05 1200**

**SECTION 05 3100  
STEEL DECKING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Composite floor deck.
- B. Related Requirements:
  - 1. Section 03 3000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of deck, accessory, and product indicated.
- 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 DELIVERY, STORAGE, AND HANDLING**

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

**2.2 COMPOSITE FLOOR DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.
4. Verco Decking, Inc., a Nucor company.

- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
  2. Profile Depth: 2 inches.
  3. Design Uncoated-Steel Thickness: 0.0358 inch.
  4. Span Condition: Triple span or more.

### **2.3 ACCESSORIES**

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

### 3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 3/4 inch, nominal.
  - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
  - 3. Weld Spacing: Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### **3.4 PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

**END OF SECTION 05 3100**

**SECTION 06 1000  
ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with timber.
3. Framing with engineered wood products.
4. Wood blocking, cants, and nailers.
5. Wood furring.
6. Wood sleepers.
7. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

**1.2 DEFINITIONS**

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSB Board of Review.

## **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## **1.6 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, GENERAL**

- A. Lumber: 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. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
  - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

### **2.2 WOOD-PRESERVATIVE-TREATED LUMBER**

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. 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.

- 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.
  3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
  5. Wood floor plates that are installed over concrete slabs-on-grade.

### **2.3 DIMENSION LUMBER FRAMING**

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load bearing.
2. Species:
  - a. Southern pine or mixed southern pine; SPIB.

- B. Load-Bearing Partitions: No. 2 grade.

1. Application: Exterior walls and.
2. Species:
  - a. Southern pine; SPIB.

- C. Ceiling Joists: Construction, Stud, or No. 3 grade.

1. Species:
  - a. Southern pine; SPIB.

### **2.4 TIMBER FRAMING**

- A. Comply with the following requirements, according to grading rules of grading agency indicated:

1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; No. 1 grade; NLGA, WCLIB, or WWPA.
2. Species and Grade: Southern pine; No. 1 grade; SPIB.
3. Maximum Moisture Content: 20 percent.
4. Additional Restriction: Free of heart centers.

### **2.5 ENGINEERED WOOD PRODUCTS**

- A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

- B. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.

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. Louisiana-Pacific Corporation.
    - b. Weyerhaeuser Company.
  2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 14-inch nominal- depth members.
  3. Modulus of Elasticity, Edgewise: 2,000,000 psi.
- C. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D5055.
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. Boise Cascade Company.
    - b. Georgia-Pacific Gypsum LLC.
    - c. Louisiana-Pacific Corporation.
    - d. Weyerhaeuser Company.
  2. Web Material: Either OSB or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1 or Plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1 .
  3. Structural Properties: Depths and design values not less than those indicated.
  4. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA-EWS standard.
- D. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.
1. Manufacturer: Provide products by same manufacturer as I-joists.
  2. Material: product made from any combination solid lumber, wood strands, and veneers.
  3. Thickness: 1-1/4 inches.
  4. Comply with APA PRR-401, rim board grade. Factory mark rim boards with APA-EWS trademark indicating thickness, grade, and compliance with APA-EWS standard.

## **2.6 MISCELLANEOUS LUMBER**

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
  3. Cants.
  4. Furring.
- B. Dimension Lumber Items: grade lumber of any species.

- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## **2.7 PLYWOOD BACKING PANELS**

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

## **2.8 FASTENERS**

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

## **2.9 MISCELLANEOUS MATERIALS**

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- C. Set rough carpentry 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.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
  - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- K. 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.
- L. 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.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  3. ICC-ES evaluation report for fastener.
- O. 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 screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches 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 INSTALLATION OF WOOD FURRING**

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

### **3.4 INSTALLATION OF WALL AND PARTITION FRAMING**

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
1. For exterior walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
  2. For interior partitions and walls, provide 2-by-4-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
  3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.

- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
  - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
  - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.
- D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use metal wall bracing, let into studs in saw kerf.

### **3.5 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING**

- A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
  - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- size or 2-by-4-inch nominal- size stringers spaced 48 inches o.c. crosswise over main ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
  - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
  - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

### **3.6 INSTALLATION OF TIMBER FRAMING**

- A. Install timber beams with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.
- B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch airspace at sides and ends of wood members.

- C. Install wood posts using metal anchors indicated.
- D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

### **3.7 INSTALLATION OF STAIR FRAMING**

- A. Provide stair framing members of size, space, and configuration indicated or, if not indicated, to comply with the following requirements:
  - 1. Size: 2-by-12-inch nominal size, minimum.
  - 2. Material: solid lumber.
  - 3. Notching: Notch rough carriages to receive treads, risers, and supports; leave at least 3-1/2 inches of effective depth.
  - 4. Spacing: At least three framing members for each 36-inch clear width of stair or as indicated on contract documents.
- B. Provide stair framing with no more than 3/16-inch variation between adjacent treads and risers and no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

### **3.8 PROTECTION**

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 1000**

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**SECTION 06 1600  
SHEATHING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

**1.2 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-preserved treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
3. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

**1.3 INFORMATIONAL SUBMITTALS**

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

#### **2.2 WOOD PANEL PRODUCTS**

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

#### **2.3 PRESERVATIVE-TREATED PLYWOOD**

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood unless otherwise indicated and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

#### **2.4 WALL SHEATHING**

- A. Plywood Sheathing:, Exterior, Structural I sheathing.
  - 1. Span Rating: Not less than 32/16.
  - 2. Nominal Thickness: Not less than 1/2 inch.

## 2.5 ROOF SHEATHING

- A. Plywood Sheathing:, Exterior, Structural I sheathing.
  - 1. Span Rating: Not less than 32/16.
  - 2. Nominal Thickness: Not less than 1/2 inch.

## 2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### **3.2 WOOD STRUCTURAL PANEL INSTALLATION**

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall and Roof Sheathing:
    - a. Screw to cold-formed metal framing.
    - b. Space panels 1/8 inch apart at edges and ends.

### **3.3 GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
- F. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
1. Install accessory materials according to sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
    - a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
    - b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
  2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
  3. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
  4. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip preformed silicone extrusion, so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
    - a. Transition Strip: Roll firmly to enhance adhesion.
    - b. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
  5. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
  6. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
  7. Seal top of through-wall flashings to sheathing with an additional 6-inch- wide, transition strip.
  8. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
  9. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches beyond repaired areas in strip direction.

**3.4 CEMENTITIOUS BACKER UNIT INSTALLATION**

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

**END OF SECTION 06 1600**

**SECTION 06 1753**  
**SHOP-FABRICATED WOOD TRUSSES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Wood roof trusses.

**1.2 DEFINITIONS**

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

**1.3 ACTION SUBMITTALS**

- A. Shop Drawings: Show fabrication and installation details for trusses.
1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
  2. Indicate sizes, stress grades, and species of lumber.
  3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
  4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
  5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
  6. Show splice details and bearing details.
- B. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator.

**1.5 QUALITY ASSURANCE**

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
  - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
  - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
  - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
  - 1. Design Loads: As indicated.
  - 2. Maximum Deflection under Design Loads:
    - a. Roof Trusses: Vertical deflection of 1/240 of span under applied Roof Live Loads.
- B. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- C. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

### **2.2 DIMENSION LUMBER**

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Provide dressed lumber, S4S.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses:.

- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

### 2.3 METAL CONNECTOR PLATES

- 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. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
  - 2. Eagle Metal Products.
  - 3. MiTek Industries, Inc.
  - 4. Truswal Systems Corporation.
- B. Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
  - 1. Use for interior locations unless otherwise indicated.

### 2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
  - 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.

### 2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Simpson Strong-Tie Co., Inc.
  - 2. USP Structural Connectors.
- B. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
  - 1. Use for interior locations unless otherwise indicated.

- D. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to one side of truss, top plates, and side of stud below.
- E. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.
  - 1. Angle clip is 3 by 3 by 0.179 by 8 inches with extended leg 8 inches long. Connector has galvanized finish.
  - 2. Angle clip is 3 by 3 by 0.239 by 10-1/2 inches with extended leg 10-1/2 inches long. Connector has painted finish.

## **2.6 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

## **2.7 FABRICATION**

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
  - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses 24 inches o.c.; adjust and align trusses in location before permanently fastening.

- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
  - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
  - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
  - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

### **3.2 REPAIRS AND PROTECTION**

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

**END OF SECTION 06 1753**

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**SECTION 07 1416  
COLD FLUID-APPLIED WATERPROOFING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Polyurethane waterproofing.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

**PART 2 - PRODUCTS**

**2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING**

- A. Two-Component, Unmodified Polyurethane Waterproofing: ASTM C 836/C 836M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. Gaco Western LLC.
    - c. Urethane Polymers International, Inc.

**2.2 AUXILIARY MATERIALS**

- A. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.
- B. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- C. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.
  - 1. Backer Rod: Closed-cell polyethylene foam.

## 2.3 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft..
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Hydrotech, Inc.
    - b. BASF Corporation.
    - c. Carlisle Coatings & Waterproofing Inc.
    - d. Urethane Polymers International, Inc.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.
- F. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M.
- G. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
- H. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
- I. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

### **3.2 WATERPROOFING APPLICATION**

- A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471/C 1471M.
- B. Reinforced Waterproofing Applications.
  - 1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 70 mils minimum .
- C. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
  - 1. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
  - 2. Molded-sheet drainage panels may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

### **3.3 MOLDED-SHEET DRAINAGE PANEL INSTALLATION**

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

### **3.4 PROTECTION**

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

**END OF SECTION 07 1416**

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**SECTION 07 2100  
THERMAL INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Extruded polystyrene foam-plastic board.
  2. Glass-fiber blanket.
  3. Loose-fill insulation.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

**PART 2 - PRODUCTS**

**2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD**

- A. Extruded Polystyrene Board, Type X: ASTM C578, Type X, 15-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Chemical Company (The).
    - b. MBCI.
    - c. Owens Corning.
  2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

## 2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced : ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Owens Corning.

## 2.3 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

## 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. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

### **3.4 INSTALLATION OF FOUNDATION WALL INSULATION**

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
  - 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
  - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
  - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

### **3.5 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 07 2100**

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**SECTION 07 2500  
WEATHER BARRIERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Building paper.
  - 2. Flexible flashing.
  - 3. Drainage material.

**1.2 ACTION SUBMITTALS**

- A. Shop Drawings: Show details of building paper at terminations, openings, and penetrations. Show details of flexible flashing applications.

**PART 2 - PRODUCTS**

**2.1 WATER-RESISTIVE BARRIER**

- A. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D.

**PART 3 - EXECUTION**

**3.1 WATER-RESISTIVE BARRIER INSTALLATION**

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
  - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.

**END OF SECTION 07 2500**

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**SECTION 07 6200  
SHEET METAL FLASHING AND TRIM**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Formed roof-drainage sheet metal fabrications.

**1.2 COORDINATION**

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

**1.3 ACTION SUBMITTALS**

- A. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

**1.4 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.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

## **2.2 SHEET METALS**

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209 , alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 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.
  - 2. Color: As selected by Architect from manufacturer's full range.
  - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil .

## **2.3 MISCELLANEOUS MATERIALS**

- A. General: 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. Elastomeric Sealant: ASTM C920, elastomeric , polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 2.4 FABRICATION, GENERAL

- A. Custom fabricate 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 on slope and location lines indicated on Drawings and within 1/8-inch 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 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 for application, but not less than thickness of metal being secured.
- G. Seams:
  - 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- H. Do not use graphite pencils to mark metal surfaces.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. 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 o.c.
  - 6. Space individual cleats not more than 12 inches 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. 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 with no joints within 24 inches of corner or intersection.
  - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch 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 for nails and not less than 3/4 inch 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 into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F , 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 .
  - 2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

### **3.3 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. Downspouts:
  - 1. Join sections with 1-1/2-inch 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 o.c.
  - 4. Provide elbows at base of downspout to direct water away from building.
  - 5. Connect downspouts to underground drainage system.
- C. Parapet Scuppers:
  - 1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
  - 3. Loosely lock front edge of scupper with conductor head.
  - 4. seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper discharge.
- E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

**3.4 INSTALLATION TOLERANCES**

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

**3.5 CLEANING**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

**3.6 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 07 6200**

**SECTION 08 4113  
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Storefront framing.
  2. Manual-swing entrance doors.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- 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.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

- C. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

## **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.

### **2.3 STOREFRONT SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. EFCO Corporation.
  - 2. Kawneer North America, an Arconic company.
  - 3. Oldcastle BuildingEnvelope™.
  - 4. Tubelite Inc.
  - 5. U.S. Aluminum; a brand of C.R. Laurence.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Exterior Framing Construction: Thermally broken.
  - 2. Interior Vestibule Framing Construction: Nonthermal.
  - 3. Glazing System: Retained mechanically with gaskets on four sides.
  - 4. Glazing Plane: Front.
  - 5. Finish: Clear anodic finish.
  - 6. Fabrication Method: Field-fabricated stick system.
  - 7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 8. Steel Reinforcement: As required by manufacturer.

- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. EFCO Corporation.
  - 2. Kawneer North America, an Arconic company.
  - 3. Oldcastle BuildingEnvelope™.
  - 4. Tubelite Inc.
  - 5. U.S. Aluminum; a brand of C.R. Laurence.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
  - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - 2. Door Design: Medium stile; 3-1/2-inch nominal width.
  - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. Cylinders: As specified in Section 087100 "Door Hardware."

## 2.6 GLAZING

- A. Glazing: Comply with Section 08 8000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B 209 .
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 .

- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
  - 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

## 2.8 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 that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

## 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. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## **2.10 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 PREPARATION**

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### **3.3 INSTALLATION**

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 9200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 08 8000 "Glazing."
- G. Install weatherseal sealant according to Section 07 9200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### **3.4 ERECTION TOLERANCES**

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet ; 1/4 inch in 40 feet .
  2. Level: 1/8 inch in 20 feet ; 1/4 inch in 40 feet .
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch .
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch .
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch .
  4. Location: Limit variation from plane to 1/8 inch in 12 feet ; 1/2 inch over total length.

**END OF SECTION 08 4113**

**SECTION 08 8000  
GLAZING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes:
  - 1. Glass for , , storefront framing.
  - 2. Glazing sealants and accessories.

**1.2 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 according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

**1.3 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## **1.6 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 .

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  - 1. Obtain tinted glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: 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. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

### **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.

### **2.4 GLASS PRODUCTS**

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

### **2.5 MISCELLANEOUS GLAZING MATERIALS**

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for

application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
  - 1. Neoprene with a Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended by sealant or glass manufacturer.
- D. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended by sealant or glass manufacturer.
- E. Edge Blocks:
  - 1. Neoprene with a Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended by sealant or glass manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

#### **3.3 GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches .
  - 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 minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### **3.4 GASKET GLAZING (DRY)**

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### **3.5 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 come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### **3.6 MONOLITHIC GLASS SCHEDULE**

- A. Glass Type : Clear fully tempered float glass.
  - 1. Minimum Thickness: 1/4".
  - 2. Safety glazing required.

**END OF SECTION 08 8000**

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**SECTION 13 3419  
METAL BUILDING SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal soffit panels.
5. Personnel doors and frames.
6. Windows.
7. Accessories.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for wall and roof insulation.
2. Section 072500 "Weather Barriers" for exterior weather barrier systems.

**1.2 DEFINITIONS**

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

**1.3 COORDINATION**

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.4 ACTION SUBMITTALS**

- A. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
  2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
    - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
    - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
  4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
    - a. Flashing and trim.
    - b. Gutters.
    - c. Downspouts.
- B. Samples for Initial Selection: For units with factory-applied finishes.
- C. Samples for Verification: For the following products:
1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
  2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
  3. Vapor-Retarder Facings: Nominal 6-inch- square Samples.
  4. Accessories: Nominal 12-inch- long Samples for each type of accessory.
- D. Delegated-Design Submittal: For metal building systems.
1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
1. Name and location of Project.
  2. Order number.
  3. Name of manufacturer.
  4. Name of Contractor.
  5. Building dimensions including width, length, height, and roof slope.
  6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
  7. Governing building code and year of edition.
  8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
  9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer.
1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
  2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, sheets, 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.

#### **1.9 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

#### **1.10 WARRANTY**

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

2. Finish Warranty Period: 10 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

## **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. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  2. Ceco Building Systems; an NCI company.
  3. Nucor Building Systems.
  4. Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

### **2.2 SYSTEM DESCRIPTION**

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: As indicated on drawings.
- H. Roof System: Manufacturer's standard standing-seam, trapezoidal-rib, metal roof panels.
1. Liner Panels: Tapered rib.
- I. Exterior Wall System: Manufacturer's standard exposed-fastener, tapered-rib, metal wall panels.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
  - 3. Deflection and Drift Limits: As indicated on the Drawings.
- C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- 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.
- E. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.
- F. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  - 1. Wind Loads: As indicated on Drawings.
- G. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- H. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- I. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- J. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

## 2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
  - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
  - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  - 3. Frame Configuration: Single gable.
  - 4. Exterior Column: Uniform depth.
  - 5. Rafter: Uniform depth.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
  - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
  - 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
  - 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
    - a. Depth: As needed to comply with system performance requirements.
  - 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
    - a. Depth: As required to comply with system performance requirements.
  - 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
  - 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch- diameter, cold-formed structural tubing to stiffen primary-frame flanges.

5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch , fabricated from zinc-coated (galvanized) steel sheet.
  7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
  9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: As indicated.
- H. Bracing: Provide adjustable wind bracing using any method as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 ; or ASTM A 529/A 529M, Grade 50 ; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
  2. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- J. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  4. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  5. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
  6. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55 , or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70 ; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 , or HSLAS, Grades 45 through 70 .
  7. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80 , or HSLAS or HSLAS-F, Grades 50 through 80 ; with G60 coating designation; mill phosphatized.
  8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80 , or HSLAS or HSLAS-F, Grades 50 through 80 ; with G90 coating designation.

- b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, SS, Grade 50 or 80 ; with Class AZ50 coating.
- 9. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for primary framing.
  - 10. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for secondary framing.
  - 11. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
    - a. Finish: Plain.
  - 12. High-Strength Bolts, Nuts, and Washers: ASTM F 3125/F 3125M, Grade A325 , Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436/F 436M, Type 1, hardened carbon-steel washers.
    - a. Finish: Plain.
  - 13. High-Strength Bolts, Nuts, and Washers: ASTM F 3125/F 3125M, Grade A490 , Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436/F 436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 14. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 3125/F 3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436/F 436M, Type 1 hardened carbon-steel washers.
    - a. Finish: Plain.
  - 15. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A 563 heavy-hex carbon steel.
    - c. Plate Washers: ASTM A 36/A 36M carbon steel.
    - d. Washers: ASTM F 436 hardened carbon steel.
    - e. Finish: Plain.
  - 16. Headed Anchor Rods: ASTM F 1554, Grade 36.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A 563 heavy-hex carbon steel.
    - c. Plate Washers: ASTM A 36/A 36M carbon steel.
    - d. Washers: ASTM F 436 hardened carbon steel.
    - e. Finish: Plain.
  - 17. Threaded Rods: ASTM A 36/A 36M.
    - a. Nuts: ASTM A 563 heavy-hex carbon steel.
    - b. Washers: ASTM A 36/A 36M carbon steel.
    - c. Finish: Plain.

- K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.
  2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil .
    - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

## 2.5 METAL ROOF PANELS

- A. Exposed Fastener, Tapered-Rib, Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Exterior Finish: Two-coat fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  2. Major-Rib Spacing: 12 inches o.c.
  3. Panel Coverage: 36 inches.
  4. Panel Height: 1.25 inches.
- B. Finishes:
1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. 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.
    - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of 0.2 mil for primer and 0.8 mil for topcoat.
  2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil .

## 2.6 METAL WALL PANELS

- A. Exposed-Fastener, Tapered-Rib, Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - a. Exterior Finish: Two-coat fluoropolymer.
  - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:
  - a. Two-Coat Fluoropolymer: AAMA 621. 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.
  - b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of 0.2 mil for primer and 0.8 mil for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil .

## 2.7 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal wall panels.
  1. Finish: Match finish and color of metal wall panels.
- C. Exposed-Fastener, Tapered-Rib-Profile, Metal Soffit Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
  1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Exterior Finish: Two-coat fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

## 2.8 THERMAL INSULATION

- A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- C. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96/E 96M, Desiccant Method.
  1. Composition: White metallized-polypropylene film facing, fiberglass scrim reinforcement, and kraft-paper backing.
  2. Composition: White film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

## 2.9 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."
- B. Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.
  1. Steel Doors: 1-3/4 inches thick; fabricated from metallic-coated steel face sheets, 0.036-inch nominal uncoated steel thickness, of seamless, hollow-metal construction; with 0.060-inch nominal uncoated steel thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
    - a. Design: Flush panel.
    - b. Core: Polystyrene foam with U-factor rating of at least 0.16 Btu/sq. ft. x h x deg F .
    - c. Glazing Frames: Steel frames to receive field-installed glass.
    - d. Glazing: As specified in Section 088000 "Glazing."
  2. Steel Frames: Fabricate 2-inch- wide face frames from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.060-inch nominal uncoated steel thickness.
    - a. Type: Knocked down for field assembly.
  3. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
  4. Hardware:
    - a. Provide hardware for each door leaf, as follows:

- 1) Hinges: BHMA A156.1. Three plain-bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches , with nonremovable pin.
  - 2) Lockset: BHMA A156.2. Key-in-lever cylindrical type.
  - 3) Exit Device: BHMA A156.3. Touch- or push-bar type.
  - 4) Threshold: BHMA A156.21. Extruded aluminum.
  - 5) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
  - 6) Closer: BHMA A156.4. Surface-applied, standard-duty hydraulic type.
  - 7) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.
- b. Provide each pair of double doors with the following hardware in addition to that specified for each leaf:
- 1) Astragal: Removable type.
  - 2) Surface Bolts: Top and bottom of inactive door.
5. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.
6. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

C. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B; free of scale, pitting, or surface defects; pickled and oiled.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS, Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

D. Finishes for Personnel Doors and Frames:

1. Prime Finish: Factory-apply manufacturer's standard primer immediately after cleaning and pretreating.
  - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
2. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 WINDOWS

A. Aluminum Windows: Metal building system manufacturer's standard, with self-flashing mounting fins, and as follows:

1. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 and as follows:

- a. Double-Hung Units: H-C25.
  2. Aluminum Extrusions: ASTM B 221 , alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch thickness at any location for main frame and sash members.
    - a. Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
  3. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
  4. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
    - a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
  5. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:
    - a. Cam-action sweep sash lock and keeper at meeting rails.
    - b. Spring-loaded, snap-type lock at jambs.
    - c. Pole-operated, cam-action locking device on meeting rail where rail is more than 72 inches above floor.
    - d. Lift handles for single-hung units.
    - e. Nylon sash rollers for horizontal-sliding units.
    - f. Steel or bronze operating arms.
  6. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric; complying with AAMA 701/702.
  7. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, and as follows:
    - a. Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.
- B. Glazing: Comply with requirements specified in Section 088000 "Glazing."
- C. Glazing:
1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), 3 mm thick.
  2. Heat-Treated Float Glass: ASTM C 1048, Type I, Quality-Q3, Class I (clear), Condition A, 3 mm thick.
  3. Tinted Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 2, 3 mm thick.
    - a. Tint Color: To be selected by Architect from manufacturer's standard colors.
  4. Patterned Glass: ASTM C 1036, Type II, Quality-Q6, Class 1 (clear), Form 3, Pattern P3 (random), 3 mm thick.

5. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of 2.5-mm-thick clear float glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
6. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.
  - a. Provide safety glazing labeling.
7. Glazing Stops: Screw-applied or snap-on glazing stops coordinated with Section 088000 "Glazing" and with glazing system indicated. Match material and finish of window frames.
8. Factory-Glazed Fabrication: Glaze window units in the factory to greatest extent possible and practical for applications indicated. Comply with requirements in Section 088000 "Glazing."

D. Finish:

1. Mill finish.
2. Baked-Enamel Finish, Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 0.7 mil , medium gloss.
  - a. Color: As selected by Architect from manufacturer's full range.

## 2.11 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
  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.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
  3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.

- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall 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- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim 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.
  2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
  2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
    - a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
    - b. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.

- c. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
  - d. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.
  - e. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
  - f. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
  3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
  4. Metal Panel Sealants:
    - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
    - b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## 2.12 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
  1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  1. Make shop connections by welding or by using high-strength bolts.
  2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
  3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
  5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  - 1. Make shop connections by welding or by using non-high-strength bolts.
  - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
  - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

#### **3.3 ERECTION OF STRUCTURAL FRAMING**

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing 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. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 3. Promptly pack 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 shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
  - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
    - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
  - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  - 2. Locate and space wall girts to suit openings such as doors and windows.
  - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," 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. Joist Installation: Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
  - 5. Joist Installation: Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints

Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

6. Joist Installation: Weld joist seats to supporting steel framework.
  7. 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.
- I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
    1. Tighten rod and cable bracing to avoid sag.
    2. Locate interior end-bay bracing only where indicated.
  - J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
  - K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

### **3.4 METAL PANEL INSTALLATION, GENERAL**

- 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. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
  1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  2. Install metal panels perpendicular to structural supports unless otherwise indicated.
  3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Locate metal panel splices over structural supports with end laps in alignment.
  6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
  - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
  - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

### **3.5 METAL ROOF PANEL INSTALLATION**

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
  - 1. Install ridge and hip caps as metal roof panel work proceeds.
  - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
  - 1. Install clips to supports with self-drilling or self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  - 4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
  - 6. Provide metal closures at peaks rake edges rake walls and each side of ridge and hip caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
  - 1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.

2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
  3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
  4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.6 METAL WALL PANEL INSTALLATION**

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
  2. Shim or otherwise plumb substrates receiving metal wall panels.
  3. When two rows of metal panels are required, lap panels 4 inches minimum.
  4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
  5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
  6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  7. Install screw fasteners in predrilled holes.
  8. Install flashing and trim as metal wall panel work proceeds.
  9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
  10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
  11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Insulated Metal Wall Panels: Install insulated metal wall panels on exterior side of girts. Attach panels to supports at each panel joint using concealed clip and fasteners at maximum 42 inches o.c., spaced not more than manufacturer's recommendation. Fully engage tongue and groove of adjacent insulated metal wall panels.
1. Install clips to supports with self-tapping fasteners.
  2. Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels as weather seal.

- D. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet , noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.7 TRANSLUCENT PANEL INSTALLATION**

- A. Translucent Panels: Attach translucent panels to structural framing with fasteners according to manufacturer's written instructions. Install panels perpendicular to supports unless otherwise indicated. Anchor translucent panels securely in place, with provisions for thermal and structural movement.
  - 1. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2-inch corrugations for metal roof panels.
  - 2. Provide end laps of not less than 4 inches and side laps of not less than 1-1/2-inch corrugations for metal wall panels.
  - 3. Align horizontal laps with adjacent metal panels.
  - 4. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

### **3.8 METAL SOFFIT PANEL INSTALLATION**

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### **3.9 THERMAL INSULATION INSTALLATION**

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
  - 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
  - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
  - 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
  - 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
  - 1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
  - 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

### **3.10 DOOR AND FRAME INSTALLATION**

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
  1. Between Doors and Frames at Jambs and Head: 1/8 inch .
  2. Between Edges of Pairs of Doors: 1/8 inch .
  3. At Door Sills with Threshold: 3/8 inch .
  4. At Door Sills without Threshold: 3/4 inch .
  5. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.
- C. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.
- D. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."
- E. Door Hardware:
  1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
  4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 079200 "Joint Sealants."

### **3.11 WINDOW INSTALLATION**

- A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer's written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
  1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.

- B. Set sill members in bed of sealant or with gaskets, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Mount screens directly to frames with tapped screw clips.

### 3.12 ACCESSORY INSTALLATION

- A. General: 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 roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. 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. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil-canning, 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 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 with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type 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 deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Tie downspouts to underground drainage system indicated.
- E. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.

- F. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- G. Louvers: Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
  - 1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
  - 2. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
  - 3. Protect galvanized- and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of corrosion-resistant paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
  - 4. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.
- H. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- I. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### **3.13 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.14 ADJUSTING**

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and at weather stripping to ensure smooth operation and weathertight closure. Lubricate hardware and moving parts.

### **3.15 CLEANING AND PROTECTION**

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
  - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- E. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
  - 1. Immediately before final inspection, remove protective wrappings from doors and frames.
- F. Windows: Clean metal surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Clean factory-glazed glass immediately after installing windows.

**END OF SECTION 13 3419**

**SECTION 22 1116  
DOMESTIC WATER PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Dielectric fittings.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.

**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.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

**2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.

G. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkhart Products Corporation.
  - b. NIBCO INC.
  - c. Viega LLC.
2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
3. Minimum 200-psig working-pressure rating at 250 deg F.

**2.3 PIPING JOINING MATERIALS**

- A. Solder Filler Metals: ASTM B 32, lead-free alloys.
- B. Flux: ASTM B 813, water flushable.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

**2.4 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. WATTS.
    - b. Wilkins.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 125 psig minimum at 180 deg F 250 psig.
  4. End Connections: Solder-joint copper alloy and threaded ferrous.

**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 shutoff valve immediately upstream of each dielectric fitting.

- C. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- L. Install sleeves for piping penetrations of walls, ceilings, and
- M. Install sleeve seals for piping penetrations of concrete walls and
- N. Install escutcheons for piping penetrations of walls, ceilings, and

### **3.2 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

- G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### **3.3 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### **3.4 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

### **3.5 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### **3.6 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
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 and larger.

### **3.7 FIELD QUALITY CONTROL**

A. Perform the following tests and inspections:

1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - 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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

### **3.8 ADJUSTING**

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
3. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.9 CLEANING**

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.

### **3.10 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- C. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. PEX tube, NPS 1 and smaller.
    - a. Fittings for PEX tube:
      - 1) ASTM F 1807, metal insert and copper crimp rings.
      - 2) ASTM F 1960, cold expansion fittings and reinforcing rings.
      - 3) ASSE 1061, push-fit fittings.

**END OF SECTION 22 1116**

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**SECTION 22 1119  
DOMESTIC WATER PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Hose bibbs.
  2. Wall hydrants.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS**

**2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES**

- A. Potable-water piping and components shall comply with NSF 61.
- B. Comply with NSF 372 for low lead.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125psig unless otherwise indicated.

**2.3 WALL HYDRANTS**

- A. Nonfreeze Wall and Roof Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Prier Products, Inc.
    - e. Tyler Pipe; a subsidiary of McWane Inc.
    - f. WATTS.
    - g. Woodford Manufacturing Company.
    - h. Zurn Industries, LLC.
  2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze Rough bronze.
12. Operating Keys(s): One with each wall hydrant.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install piping specialties as indicated on drawings.

#### **3.2 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 26 0526 "Grounding and Bonding for Electrical Systems."

#### **3.3 FIELD QUALITY CONTROL**

- A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

**END OF SECTION 22 1119**

**SECTION 22 1316  
SANITARY WASTE AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. PVC pipe and fittings.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

**2.2 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. 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.

**2.3 PVC PIPE AND FITTINGS**

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

## **PART 3 - EXECUTION**

### **3.1 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. 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.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.

- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 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 Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install aboveground PVC piping according to ASTM D 2665.
- N. Install underground PVC piping according to ASTM D 2321.
- O. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
  - 2. Install drains in sanitary waste gravity-flow piping.
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### **3.2 JOINT CONSTRUCTION**

- A. 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.

### **3.3 SPECIALTY PIPE FITTING INSTALLATION**

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: nonpressure transition couplings.

### **3.4 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install fiberglass pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42, clamps.
- B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### **3.5 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 waste and vent piping to the following:
  1. Plumbing Fixtures: Connect waste 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 waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### **3.6 IDENTIFICATION**

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### **3.7 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### **3.8 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

- D. Exposed and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

**3.9 PIPING SCHEDULE**

- A. Aboveground, soil and waste piping NPS 6 and Smaller shall be any of the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings:, nonpressure transition couplings.
- B. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings:, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings:, nonpressure transition couplings.

**END OF SECTION 22 1316**

**SECTION 23 0713  
DUCT INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply.
  - 2. Indoor, exposed supply.
  - 3. Outdoor, exposed supply and return.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

**1.6 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

**1.7 SCHEDULING**

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.

- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.

## 2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.

- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
    - d. Vimasco Corporation.
  2. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
  3. Service Temperature Range: Minus 20 to plus 180 deg F .
  4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
  5. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
  3. Service Temperature Range: 0 to 180 deg F.
  4. Color: White.

## 2.4 SEALANTS

- A. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: White.

## 2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
- D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Polyguard Products, Inc.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches .
  3. Thickness: 11.5 mils .
  4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches .
  3. Thickness: 6.5 mils .
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Venture Tape.
  2. Width: 2 inches .
  3. Thickness: 6 mils .
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.

## 2.8 SECUREMENTS

- A. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch- diameter shank, length to suit depth of insulation indicated.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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.

### 3.4 PENETRATIONS

- A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.

- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.8 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply air.
  2. Indoor, exposed supply air.
  3. Outdoor, exposed supply and return.

### **3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Exposed and Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

### **3.10 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

- B. Exposed, rectangular, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches and 3-lb/cu. ft. nominal density.
- C. Exposed, rectangular, return-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches and 3-lb/cu. ft. nominal density.

**3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. Aluminum, Smooth: 0.024 inch thick.
- D. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
  - 1. Aluminum, Smooth with 4-by-1-Inch Box Ribs: 0.032 inch thick.

**END OF SECTION 23 0713**

**SECTION 23 0743  
PACKAGED AIR CONDITIONERS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Packaged Air Conditioning Units:
    - a. Packaged Cooling
    - b. Packaged Heating
    - c. Packaged Controls

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated, include all rated capacities at scheduled design conditions, operating characteristics, general product features, options and accessories, controls, pre-programmed controls sequences, all end devices, and unit warranties provided.
- B. Shop Drawings: For air-to-air energy recovery equipment, include plans, elevations, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, corner weights, required clearances, components, and location and size of each field connection.
- C. Factory start-up, inspection, and check-out reports to be provided to engineer for review prior to final equipment acceptance, startup, or commissioning. See section 2.2 for more information.
- D. Operation and Maintenance Data to be provided with unit at shipment including Mechanical O&M and Controls Instructions and O&M.

**1.3 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. ASHRAE Compliance:
  - 1. Applicable requirements in ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."
  - 2. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2013.
  - 3. ASHRAE 90.1 and EER requirements
- C. ANSI Z83.8 and CSA 2.6 standards for gas fired equipment
- D. UL Compliance:
  - 1. Unit shall be ETL listed per UL standard 1995 and CSA standard C22.2 #236

#### **1.4 COORDINATION**

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with equipment provided.
- B. Coordinate sizes and locations of concrete bases with equipment provided.
- C. Coordinate locations of connecting utilities including: water, gas, electric, controls, and condensate with equipment provided.

#### **1.5 DELIVERY AND HANDLING**

- A. Unit shall be shipped with door handles locked shut with door handle set screws and outside air hood closed to prevent damage during transport and temporary storage.
- B. Follow IOM instructions for rigging and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the IOM.

#### **1.6 WARRANTY**

- A. Unit Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment which fail in materials or workmanship within specified warranty period. Warranty period shall begin at startup, or six months after shipment, whichever occurs first:
  - 1. Parts Warranty Period for Packaged Units: One (1) year.
  - 2. Parts Warranty Period for Compressors: Five (5) years.

#### **1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed.
  - 1. Filters: One set of each type of filter specified.

### **PART 2 - PRODUCTS**

#### **2.1 PACKAGED AIR CONDITIONERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Valent
  - 2. Semco
  - 3. Carrier
  - 4. Daikin
  - 5. Trane
- B. Unit Construction:

1. Base: Manufacturer's standard base shall be constructed of minimum 10 gage galvanized steel with 16 gage integral floor pan. All floor seams shall have a raised rib joint. Penetrations through the floor shall have a minimum 3/8" raised rib around each opening. Base shall have a minimum 4" overhang over the top of a roof curb to prevent water infiltration.
  2. Panels: Manufacturer's standard casing shall be constructed of minimum 2-inch, foam-injected, double-wall panels.
    - a. Individual panels shall be constructed so that there is no metal-to-metal contact between the interior and exterior sheet metal of each panel.
    - b. Interior side of panel shall be 22 gage G-90 galvanized steel.
    - c. Exterior side of panel shall be 22 gage pre-painted steel rated for 1000 hours of salt spray exposure in accordance with ASTM B117 and ASTM D1654.
    - d. Insulation shall be 2 lb/ft<sup>3</sup> injected foam insulation with a minimum R-value of 12. Foam sheet or fiberglass insulation are not acceptable due to reduced durability of panel and increased chance for rust forming between the panels. Insulation water absorption must be no more than 0.038 lb/ft per ASTM D2842 and show "no growth" per ASTM G21 biocide testing. Interior sheet metal shall encase insulation so that it is not exposed to the airstream.
  3. Access doors shall be provided for access to all internal components requiring regular maintenance or inspection. Access door construction and materials shall be identical to unit casing. Access doors shall have galvanized hinges and a minimum of two quarter-turn compression latches with adjustable catches. Access doors shall be sealed with a full-perimeter D-shaped gasket constructed of EPDM sponge rubber.
  4. Roof shall be pitched away from access doors and include a minimum 1/2" overhang around the perimeter of the unit.
  5. Outdoor Air Inlet: Outdoor units shall be provided with a factory provided, field-assembled weather hood with protective bird screen on the outdoor air inlet. Indoor units shall be provided with duct connections at the outdoor air inlet.
  6. Unit shall include lifting eyes on top of unit for use during rigging.
  7. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
  8. Motorized dampers – Outside Air and Return Air
    - a. Frame shall be constructed of a 16 gage galvanized steel hat-channel.
    - b. Blades shall be constructed of 16 gage galvanized steel strengthened by three longitudinal 1 inch deep "vee" grooves.
    - c. Blades shall be symmetrical relative to its axle pivot point.
    - d. Axle bearings shall be synthetic sleeve-type and rotate inside extruded holes in the damper frame.
    - e. Blade seals shall be extruded vinyl permanently bonded to the appropriate blade edges.
    - f. Frame shall include flexible stainless steel compression-type jamb seals.
    - g. Modulating spring-return actuators shall be provided by the factory, installed on the damper, and wired to the control center. Each damper shall have a dedicated actuator. Single actuators with gear trains are not acceptable.
    - h. Damper leakage shall be no more than 3 cfm/sq.ft. at 1 in.wg static pressure.
  9. Exhaust: Gravity backdraft damper with internal bird screen. Indoor units shall have duct flanges for connection to exhaust ductwork.
- C. DX Cooling Coil:
1. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.

2. Coil shall be a minimum of 4 rows deep with maximum fin density of 10 fins per inch.
3. Refrigeration systems with more than one circuit shall have interlaced evaporator coils.
4. Coil casing shall be constructed of 16 gage galvanized steel
5. Coil tubes shall be constructed of 1/2" diameter, 0.016" thick seamless copper tubing.
6. Coil fins shall be constructed of 0.0060" thick aluminum.
7. Coil shall be hydrogen or helium leak tested.
8. Drain pan
  - a. Drain pan shall be constructed of a minimum of 18 gage 201 stainless steel.
  - b. Drain pan shall be double-sloped to ensure condensate removal from unit.
  - c. Drain pan shall extend a minimum of 8" past the evaporator coil to ensure condensate retention.

D. Refrigeration – Air Cooled DX:

1. Unit shall be provided with factory piped, charged, and tested packaged air-cooled direct expansion refrigeration system.
2. Unit shall be factory charged with R-410A refrigerant.
3. Refrigeration systems 25 nominal tons and above shall be equipped with four stages of capacity control, two stages per independent circuit. Compressors shall be Variable Speed.
4. Refrigeration system shall be provided with electronic expansion valve (EXV) for use with Inverter scroll compressor incorporating adjustable superheat.

E. Hot Gas Reheat:

1. Hot-gas reheat coil shall be separated from the evaporator coil by a minimum of 6" in the direction of airflow to prevent the re-evaporation of condensate, provide room for coil cleaning, and allow control system to monitor evaporator coil leaving dew point temperature.
2. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
3. Coil casing shall be constructed of 16 gage galvanized steel
4. Coil tubes shall be constructed of 5/16" diameter, 0.012" thick seamless copper tubing.
5. Coil fins shall be constructed of 0.0060" thick aluminum fins.
6. Hot-gas reheat shall be controlled through a factory-supplied and controlled modulating 3-way valve.
7. Coil shall be hydrogen or helium leak tested.

F. Air Cooled Condenser:

1. Air cooled condenser coil shall be unit mounted.
2. Provide condenser coils with galvanized casing, seamless copper tubes, and aluminum fins.
3. Coil shall be rated in accordance to AHRI standards, designed to withstand 250 psig working pressure at 300 degrees F, and pressure tested to 600 psig.
4. Coil casing shall be constructed of 16 gage galvanized steel
5. Coil tubes shall be constructed of 5/16" diameter, 0.012" thick seamless copper tubing.
6. Coil fins shall be constructed of 0.0060" thick aluminum fins.
7. Coil shall be hydrogen or helium leak tested.
8. Condenser coils shall be mounted at a minimum 30 degree angle from vertical to help prevent hail damage.

G. Condensing Fans – Standard head pressure controls:

1. Condensing section shall be equipped with 1140 rpm direct-drive condensing fans.
2. Condensing fan assembly shall be statically and dynamically balanced in accordance with AMCA Standard 204-05.
3. Condensing fan assembly shall consist of aluminum-bladed propeller fan wheel, formed-channel base, formed inlet venturi, and coated steel basket guard on the discharge.
4. Condensing fans shall enable and stage based on fixed pressure levels in the condensing section.

H. Direct Drive Supply Airflow Blowers:

1. Fan assemblies shall be direct-drive without the use of belts or adjustable sheaves.
2. A variable frequency drive (VFD) shall be provided for each fan section. VFD shall be mounted, wired, and programmed by the equipment manufacturer. VFD shall be located in an enclosed compartment outside of the supply or exhaust air stream.
3. Fan wheels shall be constructed of welded aluminum with airfoil blades.
4. Fan wheel shall be tested in accordance to AMCA 210. Fan speed shall not exceed 2400 RPM.
5. Fans may be full width or partial width. Fans modified to partial width through the use of banding or other blade reduction method are not acceptable.
6. Fans shall be mounted on minimum 1" tall neoprene isolators.
7. Fan motor shall be VFD rated, ODP type, EPACT compliant, and shall be of premium efficiency (PE).

I. Gas Heating:

1. Unit shall be provided with AGA-certified, induced-draft, 10:1 turndown indirect gas furnace.
2. Furnace assembly shall include the following items:
  - a. Electronic modulating gas valve.
  - b. Two-speed combustion fan.
  - c. 409 stainless steel heat exchanger.
  - d. Filters
    - 1) Supply air filter rack shall accommodate 4" MERV 11 with leading 2" MERV 8 filters.
    - 2) Filter sections shall be accessible through a 2" thick, foam-injected, double-wall, hinged access door with quarter-turn latches.

J. Electrical:

1. Unit shall be constructed with an integral electrical and control center isolated from supply airflow, exhaust airflow, compressors, and heating elements. The control center shall control all aspects of the unit operation. VFDs with overload protection shall be provided for each fan bank.
2. Units shall be wired according to NEC and listed per ETL. ETL listing shall cover all components of the ventilator and not be limited to the control panel. All major electrical components shall be UL or ETL listed.
3. Unit shall have a single point of connection with integral unit mounted disconnect. Panel shall have an SCCR rating of 5 kV
4. Units shall be factory wired with a single point power connection.
5. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 7% out of balance on voltage, the voltage is more than 7% under design voltage, or on phase reversal.
6. The following items shall be provided and wired within the control center by the factory:

- a. Non-fused disconnect.
  - b. Sub-circuit fusing.
  - c. Low voltage transformers.
  - d. Controls as specified in this section.
  - e. Control circuit fusing.
  - f. Terminal block.
  - g. Supply Fan motor Variable Frequency Drives (VFDs).
  - h. Phase Loss Protection
7. Electrical panel must house all high voltage components such as terminal blocks, variable frequency drives, and fuse blocks.
  8. All electrical power and controls wiring shall run in chase located between unit ceiling and roof to minimize interior wall penetrations and allow for ease of access.
  9. Options
    - a. Control panel shall include a factory supplied and mounted 115V GFCI convenience outlet receptacle with a 12A circuit breaker. Outlet shall be powered by the main power

K. Controls:

1. Units shall include factory supplied, mounted, wired, and tested stand-alone microprocessor controls.
2. Microprocessor controller shall be factory-programmed for discharge air control and use an internal 7-day time clock.
3. Microprocessor controller shall include local liquid crystal display (LCD) for user interface. Microprocessor controller remote LCD shall be mounted in a weather-proof enclosure and accessible without exposing the operator to high voltage wiring or having to turn off or circumvent the main disconnect.
4. Microprocessor controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
5. The following sensors shall be factory supplied, mounted, and wired inside the unit:
  - a. Outdoor air humidity sensor.
  - b. Outdoor air temperature sensor.
  - c. Evaporator coil leaving air temperature sensor.
6. The following devices shall be factory-supplied for field installation and wiring:
  - a. Supply air temp temperature sensor.
  - b. Wall-mounted room air temperature sensor with manual adjuster.
  - c. Wall-mounted room air humidity sensor.
  - d. Air mounted CO2 sensor.
  - e. Supply duct static pressure sensor.
  - f. Smoke detectors.
7. Microprocessor controller shall include a Web UI interface for remote web-based access of all unit digital and analog inputs and outputs. Web UI shall include unit scheduling, point trending capabilities, and an alarm history.

## 2.2 FACTORY VERIFICATION TESTING

- A. Unit shall be thoroughly run tested prior to shipment from the factory.

- B. Factory run test report shall be provided at the request of the engineer, contractor, or owner.
- C. Testing Procedures
  - 1. Unit shall be subjected to and pass a dielectric (hipot) test.
  - 2. All motorized dampers shall be cycled one full stroke while installed in the unit using the factory-provided motorized actuators.
  - 3. Supply fan
    - a. Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
    - b. Verify fan pressure proving switch operation.
    - c. Measure and record current draw through supply fan motor(s).
  - 4. Indirect gas furnace
    - a. Indirect gas furnace shall be run tested while installed inside unit with 8.5 in.wg of natural gas.
    - b. Measure and record leaving air temperature and manifold pressure at minimum fire.
    - c. Measure and record leaving air temperature and manifold pressure and maximum fire.
  - 5. Condensing fans
    - a. Ensure fans rotate freely without obstruction.
    - b. Energize fans and ensure proper rotation.
    - c. Measure and record the amount of current draw through each condensing fan.
  - 6. Refrigeration system
    - a. Measure and record subcooling and superheat on circuit A with hot-gas reheat valve closed (0%) after 15 minutes of steady-state operation.
    - b. Measure and record subcooling and superheat on circuit A with hot-gas reheat valve open (100%) after 15 minutes of steady-state operation.
    - c. Measure and record subcooling and superheat on circuit B after 15 minutes of steady-state operation.
- D. Test report shall be provided prior to unit startup and available from the factory upon request.

### **2.3 CAPACITIES AND CHARACTERISTICS**

- A. As indicated on the drawings.

## **PART 3 - EXAMINATION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that do not comply, or are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Unit Support:
  - 1. Install floor-mounted or side discharge units on 4-inch-high housekeeping pad concrete base or minimum height required for proper unit trapping.
- B. Install units with clearances for service and maintenance.
- C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- D. Comply with ANSI Z223.1 and CGA B149.1 or CGA B149.2 for field gas piping and venting.
- E. Pipe condensate drains from drain pans to nearest floor drain.

### **3.3 CONNECTIONS**

- A. Comply with requirements for ductwork specified in Section 23 3113 "Metal Ducts."
- B. Install electrical devices furnished with units but not factory mounted.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including all connections.
- C. Tests and Inspections:
  - 1. Operational Test: After electrical circuitry has been energized and crankcase heaters have had sufficient on-time, start units to confirm proper motor rotation and unit operation.
  - 2. Enter or adjust all controller set-points as required to meet specific project requirements.
  - 3. Set initial temperature and humidity set points.
  - 4. Set field-adjustable switches as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

**3.5 SEQUENCE OF OPERATION**

- A. As indicated elsewhere in the project documents.

**3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

**END OF SECTION 23 0743**

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**SECTION 23 3113  
METAL DUCTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Single-wall rectangular ducts and fittings.
  2. Single-wall round ducts and fittings.
  3. Sheet metal materials.
  4. Sealants and gaskets.
  5. Hangers and supports.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
1. Sealants and gaskets.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- B. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

**2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ductmate Industries, Inc.
    - b. McGill AirFlow LLC.
    - c. MKT Metal Manufacturing.
    - d. SEMCO LLC.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **2.4 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: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Tie Rods: Galvanized steel, 1/4-inch- minimum .

## **2.5 SEALANT AND GASKETS**

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with 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, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## **2.6 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- C. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

## **PART 3 - EXECUTION**

### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- K. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- L. Branch Connections: Use lateral or conical branch connections.

### **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. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.3 DUCTWORK EXPOSED TO WEATHER**

- A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
  - 1. Ductwork shall be galvanized steel.
  - 2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 23 0713 "Duct Insulation."

### **3.4 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel

### 3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
  - 1. Ducts Connected to Constant-Volume Air-Handling Units :
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- C. Return Ducts:
  - 1. Ducts Connected to Air-Handling Units :
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- D. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round: 8 .

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
  - b. Round Elbows, 12Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Conical spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION 23 3113**

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**SECTION 26 0500  
ELECTRICAL GENERAL PROVISIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Work under this section consists of electrical equipment coordination and common electrical installation requirements as indicated on the accompanying drawings and specified hereafter, or as directed by Owner or Owner's representative.
- B. The following general provisions are intended to supplement these sections of the specifications. In cases of conflicting requirements, the stipulations set forth in Division 01 specification sections supersede and must be satisfied by the contractor.

**1.2 SPECIAL INSTRUCTIONS, NOT CONTAINED HEREIN**

- A. The contractor for this work is referred to the drawings, bidding requirements, general conditions, special conditions, temporary services, and other pertinent sections of these specifications for any special instructions that may affect his bid or his work on this project.

**1.3 APPLICABLE CODES AND ORDINANCES**

- A. All work on this project shall conform with all applicable Federal, State and Local Laws, Codes and Ordinances including, but not limited to the latest approved additions of the following:
  - 1. National Electrical Code (NFPA 70).
  - 2. Life Safety Code (NFPA 101).
  - 3. State Building Codes.
  - 4. Occupational Safety and Health Act (OSHA).
  - 5. Americans with Disabilities Act (ADA).
- B. Cited references, or specified portions thereof, current at the date of bidding documents, unless otherwise specified, govern the work. In conflict between cited standards and project specifications, do not proceed with any work until Architect issues written clarification.

**1.4 LICENSES, PERMITS, AND INSPECTIONS**

- A. The contractor shall secure all licenses and permits required for work on this project and shall arrange for all inspections required by all codes and/or ordinances. All such fees or charges for licenses, permits, and inspections shall be paid for by the contractor and shall be included in his bid.

**1.5 SUBMITTALS**

- A. Submit shop drawings for materials, equipment and products as specified in the following specification sections.

- B. Contractor must furnish the brand of material and equipment listed in the specifications or their approved equals. Where more than one name is listed, contractor may select any one of the various brands specified.
- C. Contractor may use in his bid any other approved equal or similar brand of material and equipment not named or specified in these specifications. In order to be considered, the contractor must request approval to bid the substitution in writing no later than ten (10) days prior to the bid date. If permitted, the substitutions will be approved by addendum.
- D. Products and manufacturers not specifically named or specified in these specifications or approved by addendum, will not be considered for use on this project.

#### **1.6 RECORD DRAWINGS**

- A. Record all deviations from the construction documents on a set of prints, and deliver to Architect upon completion of project. Special attention must be given to record the locations of concealed and buried items to facilitate future location.

#### **1.7 TEMPORARY CONSTRUCTION LIGHT AND POWER**

- A. See Section 01 5000, "Temporary Facilities and Controls" section of this specification.

#### **1.8 SYSTEM DESCRIPTION**

- A. Basic materials may include, but not limited to the following:
  - 1. Conductors and cables.
  - 2. Hangers and supports.
  - 3. Conduit, raceways, and fittings.
  - 4. Boxes.
  - 5. Nameplates and labels.
  - 6. Lighting control devices.
  - 7. Panelboards.
  - 8. Wiring devices.
  - 9. Lighting fixtures.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Materials shall be suitably packaged by manufacturer to prevent damage during shipment. Damaged materials will not be acceptable for use.
- B. Store materials on site in clean, dry storage area; when outside, elevated above grade and enclosed with durable watertight wrapping.
- C. Handle all materials carefully to prevent damage. Minor scratches, marks, or blemishes to finish shall be repaired to satisfaction of Architect.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Contractor to furnish and install only those brands of equipment listed in these specifications or accepted by addenda as substitutes.

### **2.2 MATERIALS**

- A. Provide all new materials of a quality not less than what is specified, without blemish or defect, in accord with standards specified and labeled by a Nationally Recognized Testing Laboratory (NRTL).

## **PART 3 - EXECUTION**

### **3.1 COORDINATION**

- A. Contractor is responsible for reading all specification sections covering work performed by other trades that may affect his work on this project.
- B. Coordinate work with other contractors regarding location and size of pipes, raceways, ducts, openings, switches, and outlets. Where required and possible, make minor adjustments to locations and mounting heights of equipment or apparatus to achieve coordination with equipment provided by other trades.
- C. System layout is schematic and exact locations and routing shall be determined in field based on structural elements and other conditions. All changes to system layout, other than minor adjustments required to coordinate with equipment provided by other trades, must be approved in writing by Architect before proceeding with work.
- D. Contractor is required to visit the site and fully familiarize himself with all conditions affecting the scope of work to be performed. Failure to visit the site prior to starting work shall not relieve the contractor from any responsibility regarding his work.
- E. Coordinate location, mounting, and support of equipment as follows:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide ample space for disconnecting, removal, repair, service, or other changes to equipment.
  - 3. To allow right-of-way for piping, ducts, and raceways installed at required slope.
  - 4. To insure that connecting raceways, cables, wireways, cable trays and busways will be clear of obstructions and of the working and access space of other equipment.

### **3.2 INSTALLATION**

- A. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying drawings.

- B. Include any minor items of work necessary to provide a complete and fully operational system that complies with all required codes.
- C. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".
- D. Equipment or device mounting heights are measured to the bottom of unit for suspended items, and to the center of unit for wall mounted items.
- E. In mechanical and electrical equipment spaces, expose ceiling outlets and conduit with due consideration to ventilating ducts and mechanical piping. Where numerous ducts occur, install conduits and outlets after ventilating ducts have been installed. Puncturing of ductwork or hanging equipment such as light fixtures, ceiling hangers or conduits from ductwork is prohibited.
- F. Where cutting or drilling is required to facilitate raceway penetrations, patch and repair surfaces to their original state. Do not cut or drill structural members without prior written approval of Architect.
- G. Layout holes in advance. Notify Architect prior to drilling through structural sections, for determination of proper layout.
- H. Install buried conduits that pass from building interior to the exterior, below structural footing or grade beams, unless noted otherwise.
- I. Make floor, exterior wall, and roof seals watertight. Use PVC sleeves in walls and floors for precast holes, or core drill walls and floors as approved by Architect for installation of conduit. Caulk and seal annular space around conduit as specified herein.

### **3.3 PROTECTION AND CLEANING**

- A. Protect all fixtures and equipment against damage from leaks or abuse and pay cost of repair or replacement of damaged items resulting from failure to provide suitable safeguards or protection.
- B. Repair all dents and scratches in factory prime or finish coats on all electrical equipment. Replace equipment with new if damage is excessive.
- C. Upon completion of this project, contractor shall be required to:
  - 1. Thoroughly clean all fixtures and equipment with manufacturer's recommended cleaning agents.
  - 2. Remove stickers, tags, marking, and other foreign matter from all fixtures and equipment.
  - 3. Remove all markings on equipment and building surfaces placed during construction by this contractor.
  - 4. Remove all waste, scrap, excess, and offal entirely from site.
  - 5. Provide any other clean-up services as required to leave every aspect of work in an acceptable, clean and ready-to-use condition.

**END OF SECTION 26 0500**

**SECTION 26 0519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Control-voltage conductors and cables.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0533 - Raceways and Boxes for Electrical Systems.
4. Section 26 0553 - Identification for Electrical Systems.

**1.2 DEFINITIONS**

A. RoHS: Restriction of Hazardous Substances.

B. Control-Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

**1.3 ACTION SUBMITTALS**

A. Product Data: For each type of product.

B. Include data sheets for the following additional items:

1. Splices and terminations.
2. Pulling compounds.
3. Cable accessories.

**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. Comply with ASTM.

C. Comply with UL 44, 83, and 486.

- D. Comply with NFPA 70.
- E. Comply with ANSI.
- F. Perform work in accordance with NECA "Standard of Installation".

## **PART 2 - PRODUCTS**

### **2.1 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Belden Inc.
  - 2. General Cable Corporation.
  - 3. Southwire Company.
  - 4. Okonite Company.
- B. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- E. Conductors: Annealed copper, complying with NEMA WC 70/ICEA S-95-658.
- F. Cable: Comply with NEMA WC 70 for armored cable Type MC, Type SO, and Type USE with ground wire.

### **2.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type THHN/THWN, Type XHHW, or Type USE single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN, Type XHHW single conductors in raceway, or underground feeder cable, Type UF.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- F. Feeders in Cable Tray: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.

- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN, Type XHHW single conductors in raceway, or underground feeder cable, Type UF.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- K. Branch Circuits in Cable Tray: Type THHN/THWN, Type XHHW single conductors in raceway, or metal-clad cable Type MC where permitted in NFPA 70 for intended location and application.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### **2.3 CONTROL VOLTAGE CABLE**

- A. Paired Cable: NFPA 70, Type CMG.
  - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  - 2. PVC insulation jacket.
  - 3. Unshielded.
  - 4. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
  - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  - 2. PVC insulation jacket.
  - 3. Unshielded.
  - 4. Flame Resistance: Comply with NFPA 262.
- C. Low-voltage control cables shall be installed in raceways where concealed in walls, floors or above ceilings. Low-voltage control cables may be installed exposed in open air provided the following criteria are satisfied.
  - 1. Cables are not subject to damage.
  - 2. Cables are provided with plenum rated jackets when installed in environmental air spaces.
  - 3. Cables are properly supported by J-hooks and/or bridle rings.

### **2.4 CONTROL CIRCUIT CONDUCTORS**

- A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN in raceway, complying with UL 83.

- B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN in raceway, complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

## **2.5 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M Electrical Products.
  - 2. Hubbell Power Systems, Inc.
  - 3. Ideal Industries, Inc.
  - 4. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 1. Above grade circuits (No. 10 AWG and smaller):
    - a. Conductors shall be spliced together using solderless, screw-on, reusable pressure cable type connectors, rated 600 V, 90° C, with integral insulation, approved for copper conductors.
    - b. The integral insulator shall have a skirt to completely cover the stripped wires.
    - c. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.
  - 2. Above grade circuits (No. 8 AWG and larger):
    - a. Conductors shall be spliced together using cable termination lugs made of high conductivity and corrosion-resistant material, electro-tin plated, listed for use with copper conductors only, rated for 600 V. Lugs shall be color coded by size.
    - b. Cable termination lugs shall be compression indent type, long barrel with chamfered entry; 1-hole type for less than 250 kcmil conductors, and 2-hole type for 250 kcmil conductors and above.
    - c. Install taped covering on cable termination lugs to maintain rated insulation level.
  - 3. Where not provided with equipment, use mechanical type lugs (allen-head screw type) to terminate wire.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION AND PREPARATION**

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.
- C. Verify that raceway installation is complete and supported.

- D. Verify that field measurements are as indicated.
- E. Examine walls, floors, roofs, and other construction for suitable conditions where electrical wiring and cabling will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Completely and thoroughly swab raceway before installing wire.

### **3.2 CONDUCTOR MATERIAL APPLICATIONS**

- A. Minimum Wire Size:
  - 1. #14 AWG conductors for lighting fixture whips in lengths not to exceed six (6) feet, unless noted otherwise.
  - 2. #12 AWG for power and lighting circuits, unless noted otherwise.
  - 3. #16 AWG conductors for low-voltage control cables and control circuit conductors, unless noted otherwise.
  - 4. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Conductor sizes are based on copper. Unless the equipment is listed and marked otherwise, conductor ampacities used in determining equipment termination provisions shall be based on NEC Table 310.15(B)(16) as appropriately modified by 310.15(B)(6).
- C. If aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors. Verify the acceptance of using aluminum conductor with the Architect prior to designing around this type of conductor system.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Multi-wire branch circuits complying with the NEC Article 210.4 will be acceptable. Provide each multi-wire branch with a means to simultaneously disconnect all ungrounded conductors at the origin of the branch circuit complying with the NEC Sections 210.4.B and 240.15.B. The ungrounded and grounded circuit conductors of each multi-wire branch circuit shall be grouped together complying with NEC Section 210.4.D.
- B. Wire and cable routing indicated is approximate unless dimensioned. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- C. All feeder and branch circuit wiring shall be installed in raceways concealed in finished walls, ceilings, and floors unless otherwise indicated.
- D. Complete raceway installation between conductor and cable termination points according to Section 26 0533 - Raceways and Boxes for Electrical Systems, prior to pulling conductors and cables. Homerun conductors shall be installed unspliced from panelboard to first device or junction box.
- E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- H. Support cables according to Section 26 0529 - Hangers and Supports for Electrical Systems.
- I. Complete cable tray systems installation according to Section 26 0536 - Cable Trays for Electrical Systems, prior to installing conductors and cables.
- J. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.5 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 26 0553 - Identification for Electrical Systems.
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.6 FIELD QUALITY CONTROL**

- A. After installing conductors and cables and before electrical circuitry has been energized, test service entrance feeder conductors, branch circuit conductors, and control circuit conductors to determine continuity of wiring and connection.
- B. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace non-compliant cables or wires and retest as specified above.
- D. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

**END OF SECTION 26 0519**

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**SECTION 26 0526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes grounding and bonding systems and equipment, as shown or implied in the contract documents.
- B. Related Sections:
  - 1. Section 26 0500 - Electrical General Provisions.
  - 2. Section 26 0519 - Low Voltage Electrical Power Conductors and Cables.
  - 3. Section 26 0533 - Raceways and Boxes for Electrical Systems.
  - 4. Section 26 2416 - Panelboards.
  - 5. Section 26 2726 - Wiring Devices.
  - 6. Section 26 5000 - Lighting Fixtures.

**1.2 DEFINITIONS**

- A. Equipment Ground Conductor (EGC):
  - 1. The conductor that connects the non-current-carrying metal parts of equipment to the grounding electrode system or ground bus.
- B. Grounding Electrode Conductor (GEC):
  - 1. The conductor that connects the grounding electrodes to the grounded circuit conductor and/or the equipment grounding conductor.
- C. Grounded Circuit Conductor (GCC):
  - 1. A circuit conductor, usually the neutral that is intentionally connected to ground.
- D. Isolated Ground Conductor (IG):
  - 1. A conductor or system that connects equipment directly to the point of electrode grounding connection. May also be referred to as single point ground.
- E. Made Electrode (ME):
  - 1. Any item, such as ground rod, which is used to provide a ground connection.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Plans showing dimensioned as-built locations of grounding features including the following:
  - 1. Ground rods.

2. Ground rings.

#### **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. Comply with ASTM.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with NFPA 70.
- E. Comply with ANSI.
- F. Perform work in accordance with NECA "Standard of Installation".

### **PART 2 - PRODUCTS**

#### **2.1 CONDUCTORS**

- A. Insulated Grounding Conductors: Copper or tinned-copper wire or cable insulated for 600 V with solid green colored insulation jacket, UL 44 or UL 83 listed, sized in accordance with NFPA 70, unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
  4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V. Provide clear Lexan cover over connections

#### **2.2 CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Burndy; Part of Hubbell Electrical Systems.
  2. ERICO International Corporation.
  3. ILSCO.

4. Thomas & Betts Corporation; A Member of the ABB Group.
  - B. Products listed and labeled by a Nationally Recognized Testing Laboratory acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
  - C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
  - D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
  - E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
  - F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
  - G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
  - H. Conduit Hubs: Mechanical type, terminal with threaded hub.
  - I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt socket set screw.
  - J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
  - K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
  - L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
  - M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
  - N. Straps: Solid copper, copper lugs. Rated for 600 A.
  - O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
  - P. Water Pipe Clamps:
    1. Mechanical type, two pieces with zinc-plated bolts.
      - a. Material: Die-cast zinc alloy.
      - b. Listed for direct burial.
    2. U-bolt type with malleable-iron clamp and copper ground connector.

### **2.3 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 8 feet long, unless noted otherwise.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

## **PART 3 - EXECUTION**

### **3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
  - 2. Provide detectable warning tape approximately 6 inches above grounding conductors. Warning tape shall comply with Section 26 0553 – Identification for Electrical Systems.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.

### **3.2 UTILITY GROUNDING**

- A. Provide grounding and bonding at Utility Company's metering equipment in accordance with Utility Company's requirements.

### **3.3 GROUNDING AT THE SERVICE**

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.
- B. Ground electrical service neutral at service entrance equipment to metal underground water pipe and supplementary made electrodes.

### **3.4 EQUIPMENT GROUNDING**

- A. Install an insulated equipment grounding conductor with all feeders and branch circuits, minimum size per NFPA 70, bonded to ground bar in panelboard where circuit originates and to other panelboards ground bars, receptacles, equipment, etc. Conduit shall not be used as the ground conductor.

- B. Bond all raceways, cabinet enclosures, and non-current carrying parts of equipment to grounding system. Conduit system shall be bonded so that a continuous path for current flow is maintained.
- C. Bond all feeder raceways to panelboard grounding bars with bonding jumper and approved bushing.
- D. Bond lighting fixtures to the branch circuit equipment grounding conductor. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- E. Signal, data, and communication equipment shall be grounded and bonded in accordance with NFPA 70 requirements.
  - 1. For telephone, alarm, voice, data, and other communication equipment, provide a minimum #6 AWG insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4 by 4 inches in cross section grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Verify that final backfill has been completed before driving ground rods.
  - 2. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 3. Use exothermic welds for all below-grade connections.
  - 4. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building area or item indicated.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches from building's foundation.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG, or use electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. 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.

### 3.6 FIELD QUALITY CONTROL

- A. Perform inspections and tests using suitable ground testing equipment.

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
1. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

**END OF SECTION 26 0526**

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**SECTION 26 0529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Hangers and supports for electrical equipment and systems.
- B. Related Sections:
  - 1. Section 26 0500 - Electrical General Provisions.
  - 2. Section 26 0533 - Raceways and Boxes for Electrical Systems.
  - 3. Section 26 2416 - Panelboards.
  - 4. Section 26 5000 - Lighting Fixtures.
  - 5.

**1.2 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

**1.3 SUBMITTALS**

- A. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Trapeze hangers.
  - 2. Steel slotted-channel systems.
  - 3. Equipment supports.

**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. Comply with ASTM.
- C. Comply with NFPA 70.
- D. Comply with ANSI.
- E. Perform work in accordance with NECA "Standard of Installation".

## 1.5 PERFORMANCE AND COORDINATION REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected equipment and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed, with a minimum structural safety factor of five times the applied force.
- D. Coordinate installation of roof curbs, equipment supports, and roof penetrations with Division 07 contractor.
- E. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work.
- F. Coordinate installation locations of electrical switchboards, panelboards, disconnect switches, circuit breaker enclosures, control enclosures, raceways, lighting fixtures, junction and pull boxes with all mechanical, plumbing and fire protection trades prior to installation of equipment and systems.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. B-line, an Eaton business.
    - b. ERICO International Corporation.
    - c. Thomas & Betts Corporation; A Member of the ABB Group.
    - d. Unistrut; Part of Atkore International.
  - 2. Material: Galvanized Steel.
  - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Hilti, Inc.
    - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 3) MKT Fastening, LLC.
    - 4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) B-line, an Eaton business.
    - 2) Hilti, Inc.
    - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 4) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## **2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 5000 - Metal Fabrications, for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as scheduled in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structural members as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with strength and anchorage requirements.
  - 9. Install surface mounted cabinets and panelboard enclosures with a minimum of four (4) anchors. In wet or damp locations, cabinets and panelboard enclosures shall be spaced off the wall surface a minimum of 1 inch using steel channel supports or strut.
  - 10. Conduits installed in the interior or exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using clamp-back straps or strut.
  - 11. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
  - 12. Do not drill or cut structural members without prior written approval of Architect.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 05 5000 - Metal Fabrications, for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### **3.4 PAINTING**

- A. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
  - 1. Clean field welds and abraded areas of shop paint.
  - 2. Paint exposed areas immediately after erecting hangers and supports.
  - 3. Use same materials as used for shop painting.
  - 4. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 5. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 26 0529**

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**SECTION 26 0533  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0519 - Low Voltage Electrical Power Conductors and Cables.
3. Section 26 0526 - Grounding and Bonding for Electrical System.
4. Section 26 0529 - Hangers and Supports for Electrical Systems.
5. Section 26 0553 - Identification for Electrical Systems.

**1.2 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.
- D. RMC: Rigid metal conduit.
- E. EMT: Electrical metallic tubing.
- F. FMC: Flexible metal conduit.
- G. LFMC: Liquidtight flexible Metal conduit.
- H. ENT: Electrical nonmetallic tubing.
- I. RNC: Rigid nonmetallic conduit.
- J. LFNC: Liquidtight flexible nonmetallic conduit.
- K. HDPE: High-density polyethylene.
- L. RTRC: Reinforced thermosetting resin conduit.
- M. PVC: Polyvinyl chloride.

### **1.3 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### **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. Comply with ASTM.
- C. Comply with NFPA 70.
- D. Comply with ANSI.
- E. Perform work in accordance with NECA "Standard of Installation".

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Accept conduit on site and inspect for damage before use.
- B. Protect conduit from corrosion and entrance of debris by covering and storing above grade.
- C. Protect PVC conduit from direct sunlight.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they have a smooth interior, are listed and labeled by a qualified testing agency as defined in NFPA 70 for intended location and application. Conduit and fittings shall be obtained from the same manufacturer.
- B. Metal Conduit:
  - 1. ARC: Comply with ANSI C80.5 and UL 6A.
  - 2. GRC: Comply with ANSI C80.1 and UL 6.
  - 3. IMC: Comply with ANSI C80.6 and UL 1242.
  - 4. RMC: Comply with ANSI C80.1 and UL 6.
  - 5. EMT: Comply with ANSI C80.3 and UL 797.
  - 6. FMC: Comply with UL 1; zinc-coated steel.
  - 7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
  - 8. PVC-Coated Steel Conduit: PVC-coated IMC.
    - a. Comply with NEMA RN 1.
    - b. Coating Thickness: 0.040 inch, minimum.

C. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
4. Fittings for RMC:
  - a. Material: Steel.
  - b. Type: Threaded.
5. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: Set screw – indoors: Compression - outdoors.
6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Fittings for flexible conduit: NEMA FB 1 listed and labeled for type and size of raceway used, and for application and environment in which installed.
9. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they have a smooth interior, are sunlight resistant, and are listed and labeled by a qualified testing agency as defined in NFPA 70 for intended location and application. Conduit and fittings shall be obtained from the same manufacturer.
2. Fiberglass:
  - a. Comply with NEMA TC 14.
  - b. Comply with UL 2515 for aboveground raceways.
  - c. Comply with UL 2420 for belowground raceways.
3. ENT: Comply with NEMA TC 13 and UL 1653.
4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Comply with UL 651A.
7. Continuous HDPE: Comply with UL 651A.
8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
9. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.

2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Fittings for LFNC: Comply with UL 514B.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

### **2.3 BOXES**

- A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they are listed and labeled by a qualified testing agency as defined in NFPA 70 for intended location and application. Fittings shall be obtained from the same manufacturer.
- B. General Requirements for Boxes: Boxes installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
  1. Material: Cast metal or sheet metal.
  2. Type: Fully adjustable.
  3. Shape: Round or Rectangular.
  4. Flush cover appropriate for use on carpet, tile, or wood-covered flooring as required.
- G. Nonmetallic Floor Boxes:
  1. Material: PVC.
  2. Type: Nonadjustable.
  3. Shape: Round or rectangular.
  4. Flush cover appropriate for use on carpet, tile, or wood-covered flooring as required.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum, galvanized steel, or cast iron with gasketed cover.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep .
- N. Gangable boxes are allowed.

## **PART 3 - EXECUTION**

### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC, IMC, RNC Type EPC-40-PVC, or RNC Type EPC-80-PVC.
  2. Concealed Conduit, Aboveground: GRC, IMC, EMT, or RNC Type EPC-40-PVC.
  3. Underground Conduit: RNC Type EPC-40-PVC, or Type EPC-80-PVC, direct buried, or concrete encased.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT, ENT or RNC.
  2. Exposed, Not Subject to Severe Physical Damage: RNC identified for such use.
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT, ENT, or RNC Type EPC-40-PVC.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use steel set-screw fittings for indoor applications and steel compression fittings for outdoor applications. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 26 0529 - Hangers and Supports for Electrical Systems, for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not fasten conduits onto the bottom side of a metal deck roof.
- D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Complete raceway installation before starting conductor installation.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to RNC, Type EPC-40-PVC, GRC or IMC before rising above floor.
- L. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated, as follows:
1. Switches: 48 inches above finished floor.
  2. Receptacles or telephone/data outlets: 16 inches above finished floor.
  3. Telephone/data outlets next to door: 56 inches above finished floor.
  4. Outdoor receptacles: 24 inches above grade or roof surface.
  5. Switches, receptacles, or telephone/data outlets at counters: 12 inches above surface.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. When flush mounted boxes are installed back-to-back in walls, provide a barrier between boxes consisting of two layers of 5/8" gypsum wallboard to minimize sound transfer and maintain fire rating where applicable. If barrier is not installed between back-to-back boxes, provide minimum 6 inch horizontal separation. Provide minimum 24 inch separation in acoustic-rated walls.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Install direct buried conduit in compliance with Division 31 requirements, or in the absence of Division 31 sections, install direct buried conduit as follows:
  - a. Excavate by open cut to depths indicated on drawings, or as necessary to provide NFPA 70 minimum required depths, if more stringent.
  - b. Over-excavate organic, soft, spongy, or otherwise unsuitable soils found at or below the bottom of the trench to achieve firm subsoil condition.
  - c. Trenches in non-pavement and non-structure areas:
    - 1) After conduit installation is complete, backfill and compact utilizing native backfill material. Start at tie-in point and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand-tamp backfill material around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction leaving a mound on the surface to accommodate future settlement.
  - d. Trenches under pavement or structures and within 5 feet of same:
    - 1) After conduit installation is complete, backfill with compacted aggregate to 95% standard proctor density in 8 inch maximum lifts. Start at tie-in point and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand-tamp backfill material around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling.
2. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
3. Underground Warning Tape: Comply with requirements in Section 260553 - Identification for Electrical Systems. Bury warning tape approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align tape along centerline of conduit.

### **3.4 SLEEVES FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at raceway penetrations of exterior floor and wall assemblies.
  - 1. Cut sleeves to length for mounting flush with both surfaces of wall.
  - 2. Extend sleeves installed in floors 2 inches above finished floor.
  - 3. Size pipe sleeves to provide 1/4 inch annular clear space around raceway, unless sleeve seal is to be installed.
- B. Concrete Slabs and Below Grade Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls
  - 1. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 1. Sleeves for rectangular openings: Galvanized sheet steel of length required to suit application.
    - a. For rectangular perimeter cross-section less than 50 inches and no side greater than 16 inches, minimum thickness shall be 0.052 inches.
    - b. For rectangular perimeter cross-section equal to or greater than 50 inches and one or more sides equal to, or greater than 16 inches, minimum thickness shall be 0.138 inches.
- D. Seal space outside of sleeves with grout for penetrations of concrete and masonry, and with approved joint compound for gypsum board assemblies.
- E. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location. Refer to Division 07 Section - Joint Sealants, for materials and installation requirements
- F. Roof Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- G. Above ground Exterior Wall 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.

### **3.5 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION 26 0533**

**SECTION 26 0553  
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Equipment identification nameplates.
7. Miscellaneous identification products.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0519 - Low Voltage Electrical Power Conductors and Cables.
3. Section 26 0533 - Raceways and Boxes for Electrical System.

**1.2 SUBMITTALS**

- A. Product Data: For each type of electrical identification product.

**1.3 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Perform work in accordance with NECA "Standard of Installation".

**PART 2 - PRODUCTS**

**2.1 RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on a white field.
  2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
  2. Legend: "DANGER - HIGH VOLTAGE".
- D. Self-Adhesive Vinyl Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends. Labels sized to fit the raceway diameter, such that the clear shield overlaps the entire printed legend.
- E. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceways they identify, and that stay in place by gripping action.

## **2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends. Labels sized to fit the cable diameter, such that the clear shield overlaps the entire printed legend.
- C. Write-On Tags: Polyester tags, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to cable.
1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.3 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Self-Adhesive Vinyl Tape: Colored, self-adhesive, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tags, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to cable.
1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.4 FLOOR MARKING TAPE**

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

## **2.5 UNDERGROUND WARNING TAPE**

- A. Tape: Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 1. Width: Minimum 4 inches wide by 4 mils thick.
  - 2. Minimum letter height shall be 1 inch.
  - 3. Detectable continuous embedded metallic strip or core.
  - 4. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 5. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 6. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

## **2.6 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Signs: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

## **2.7 EQUIPMENT IDENTIFICATION NAMEPLATES**

- A. Engraved, laminated acrylic or melamine plastic label, minimum 1/16 inch thick, with white letters on black background.
- B. Nameplate shall be punched or drilled for self-tapping stainless steel screws or stainless-steel machine screws with nuts and flat and lock washers. Self-adhesive nameplates are not permitted.

## **2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Toggle switch labels shall be hot stamped or engraved machine printing with 3/16 inch high black filled letters on face of plate.
- B. Receptacle labels shall be hot stamped or engraved machine printing with 3/16 inch high black filled letters on face of plate with durable wire markers on inside of box.
- C. Communications outlet labels shall be machine printed paper insert with black lettering located under clear label cover on face of plate with durable wire markers on inside of box.
- D. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

- E. Covers for all junction boxes containing emergency circuits shall be painted red.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

#### **3.2 IDENTIFICATION SCHEDULE**

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box with self-adhesive vinyl labels containing the wiring system legend, system voltage, and panel/circuit number.
- B. Color Coding for Phase and Voltage Level Identification: Use wire insulation colors listed below for feeder and branch-circuit conductors.
  - 1. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
    - e. Ground: Green.
  - 2. Color code all conductors and cables larger than color coded sizes available from manufacturer with field-applied, color-coding conductor tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or

- taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
3. Switch loops may be any pastel color other than white, grey or green.
- C. Control Circuit Conductor Identification: Use write-on tags or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- D. Conductors To Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, communications, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- F. Communication Outlet Identification: Use labels to identify each outlet connection. Use system of designation that is uniform and consistent with cable identification. Use wire markers for cable inside of box to identify system and circuit designation. Label face of plate where indicated on drawings.
- G. Receptacle Identification: Use labels to identify each outlet connection. Use system of designation that is uniform and consistent with conductor identification. Use wire markers for conductors inside of box to identify panelboard and circuit number. Label face of plate where indicated on drawings.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceways.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels to exterior of door, cover, or other access.
1. Identify system voltage.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
  3. For equipment requiring workspace clearance according to NFPA 70, apply warning label to door or cover of equipment. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
  4. Color Scheme:
    - a. Emergency Warning Labels: Red letters on white background.
    - b. All Other Warning Labels: Black letters on yellow background.

5. Warning labels and signs shall include, but are not limited to, the following legends:
  - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES".
  - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES".
  
- K. Operating Instruction Signs: Install instruction signs with black letters on white background with minimum 3/8-inch-high letters to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
  
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for emergency shutdown of generator.
  
- M. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Install nameplate unless equipment is provided with its own identification.
  1. Labeling Instructions:
    - a. Wording on nameplate shall contain the following:
      - 1) Equipment designation.
      - 2) System voltage.
  
    - b. For the following equipment, provide a single line of text with 1/2 inch high letters on 1-1/2 inch high nameplate; where two lines of text are required, use nameplates 2 inches high:
      - 1) Panelboards.
      - 2) Enclosures and electrical cabinets.
      - 3) Disconnect switches.
  
    - c. For the following equipment, provide a single line of text with 1/4 inch high letters on 1 inch high nameplate; where two lines of text are required, use nameplates 1-1/2 inches high:
      - 1) Access doors and panels for concealed electrical items.
      - 2) Contactors and timeclocks.
  
    - d. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

**END OF SECTION 26 0553**

**SECTION 26 0923  
LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Photoelectric switches.
  - 2. Lighting contactors.
- B. Related Sections:
  - 1. Section 26 0500 - Electrical General Provisions.
  - 2. Section 26 0519 - Low Voltage Electrical Power Conductors and Cables.
  - 3. Section 26 0533 - Raceways and Boxes for Electrical Systems.
  - 4. Section 26 5000 - Lighting Fixtures.

**1.2 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Submit installation details and typical wiring diagrams for all components including interconnection diagrams showing field-installed wiring.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Perform work in accordance with NECA "Standard of Installation".

**1.5 COORDINATION**

- A. Coordinate layout and installation of ceiling mounted devices with other construction that penetrates ceilings or is supported by them including luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. NSi Industries LLC.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected load, complying with UL 773A, and compatible with ballasts and LED lamps.
  - 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
  - 2. Time Delay: 30-second minimum, to prevent false operation.
  - 3. Surge Protection: Metal-oxide varistor.
  - 4. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
  - 5. Failure Mode: Luminaire stays ON.

### 2.2 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company.
  - 3. Square D.
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.
  - 4. Provide with control and pilot devices as indicated on Drawings or scheduled, matching the NEMA type specified for the enclosure.

### **2.3 CONDUCTORS AND CABLES**

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Mount lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.
- D. Wiring Method: Comply with Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables. Minimum conduit size is 1/2 inch.
- E. Wiring within Enclosures: Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- F. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- G. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

**3.3 IDENTIFICATION**

- A. Identify components and power and control wiring according to Section 26 0553 - Identification for Electrical Systems.
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label contactors with a unique designation.

**3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

**END OF SECTION 26 0923**

**SECTION 26 2416  
PANELBOARDS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Main distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.
4. Accessory components and features.
5. Identification.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0553 - Identification for Electrical Systems.

**1.2 DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

**1.3 SUBMITTALS**

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

#### **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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Do not install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### **1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.

## 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches maximum.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
  - 5. Directory Card: Typewritten card inside panelboard door, mounted in metal frame with transparent protective cover.
- F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
  - a. Plating shall run entire length of bus.
  - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## **2.2 MAIN DISTRIBUTION PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Energy.
  4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or main lugs only, as indicated on Drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## **2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Energy.
  4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products of same manufacturer as the panelboard.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  - 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 8. Subfeed Circuit Breakers: Vertically mounted.
  - 9. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

- h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
- i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
- j. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
- k. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 - Cast-in-Place Concrete.
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.

- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

### **3.3 IDENTIFICATION**

- A. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- B. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 - Identification for Electrical Systems.
- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 - Identification for Electrical Systems.
- E. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 - Identification for Electrical Systems.
- F. Install warning signs complying with requirements in Section 260553 - Identification for Electrical Systems, identifying source of remote circuit.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
  2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

**END OF SECTION 26 2416**

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**SECTION 26 2726  
WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Toggle switches, 120/277 V, 20 A.
4. Wall plates.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0533 - Raceways and Boxes for Electrical Systems.
4. Section 26 0553 - Identification for Electrical Systems.

**1.2 DEFINITIONS**

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

**1.4 QUALITY ASSURANCE**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
- C. Comply with NFPA 70.
- D. Perform work in accordance with NECA "Standard of Installation".

## **1.5 COORDINATION**

- A. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.
- B. Devices for Owner-Furnished Equipment and Equipment Furnished by Others:
  - 1. Receptacles: Match plug configuration.
  - 2. Cord and Plug Sets: Match equipment requirements.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: Coordinate color selection with Architect, unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
  - 3. Isolated Ground Receptacles: Orange.
  - 4. SPD Receptacles: Blue.
- B. Wall Plate Color: For non-metallic covers, match device color.

### **2.2 MANUFACTURERS**

- A. Manufacturers' Names: Abbreviations of manufacturers' names shown in parentheses.
  - 1. Cooper Wiring Devices (Arrow Hart).
  - 2. Hubbell Wiring Device-Kellems (Hubbell).
  - 3. Leviton Manufacturing Co., Inc. (Leviton).
  - 4. Legrand (Pass & Seymour).

### **2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20A**

- A. Duplex Receptacles, 125 V, 20A :
  - 1. Description: Two pole, three wire, and self-grounding.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.

- B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498 and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Weather-Resistant Duplex Receptacle, 125 V, 20 A :
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A :
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

## **2.4 GFCI RECEPTACLES, 125 V, 20 A**

- A. Duplex GFCI Receptacles, 125 V, 20 A :
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Type: Feed through.
    - a. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
  4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A :
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Type: Feed through.
    - a. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
  4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A :

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Feed through.
  - a. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

**2.5 TOGGLE SWITCHES, 120/277 V, 20 A**

A. Single-Pole Switches, 120/277 V, 20 A :

1. Standards: Comply with UL 20 and FS W-S-896.

B. Antimicrobial, Single-Pole Switches, 120/277 V, 20 A :

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Standards: Comply with UL 20 and FS W-S-896.

C. Two-Pole Switches, 120/277 V, 20 A :

1. Comply with UL 20 and FS W-S-896.

D. Antimicrobial, Double-Pole Switches, 120/277 V, 20 A :

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Standards: Comply with UL 20 and FS W-S-896.

E. Three-Way Switches, 120/277 V, 20 A :

1. Comply with UL 20 and FS W-S-896.

F. Antimicrobial, Three-Way Switches, 120/277 V, 20 A :

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Standards: Comply with UL 20 and FS W-S-896.

G. Four-Way Switches, 120/277 V, 20 A :

1. Standards: Comply with UL 20 and FS W-S-896.

- H. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A :
  - 1. Description: Illuminated when switch is on.
  - 2. Standards: Comply with UL 20 and FS W-S-896.
- I. Lighted Single-Pole Switches, 120/277 V, 20 A :
  - 1. Description: Handle illuminated when switch is on.
  - 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- J. Key-Operated, Single-Pole Switches, 120/277 V, 20 A :
  - 1. Description: Factory-supplied key in lieu of switch handle.
  - 2. Standards: Comply with UL 20 and FS W-S-896.
- K. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A :
  - 1. Description: For use with mechanically held lighting contactors.
  - 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- L. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A :
  - 1. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
  - 2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

## 2.6 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
- D. Antimicrobial Cover Plates:
  - 1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
  - 2. Tarnish resistant.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
  2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### **3.2 IDENTIFICATION**

- A. Comply with Section 26 0553 - Identification for Electrical Systems.

### **3.3 FIELD QUALITY CONTROL**

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
1. In healthcare facilities, prepare reports that comply with NFPA 99.
  2. Test Instruments: Use instruments that comply with UL 1436.
  3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade hospital-grade outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- F. Wiring device will be considered defective if it does not pass tests and inspections.

**END OF SECTION 26 2726**

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**SECTION 26 5000  
LIGHTING FIXTURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Interior luminaires, ballasts, and lamps.
2. Luminaire supports.
3. Exterior luminaires.

B. Related Sections:

1. Section 26 0500 - Electrical General Provisions.
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0529 - Hangers and Supports for Electrical Systems.
4. Section 26 0923 - Lighting Control Devices.

**1.2 DEFINITIONS**

A. BF: Ballast Factor.

B. CCT: Correlated Color Temperature.

C. CRI: Color Rendering Index.

D. LED: Light emitting diode.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.3 SUBMITTALS**

A. Product Data: For each type of luminaire, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:

1. Material and physical description of luminaires including dimensions.
2. Emergency lighting units including battery and charger.
3. Low voltage transformers.
4. LED power supplies
5. Energy-efficiency data.
6. Life, output (lumens, CCT, and CRI), and energy efficiency data for lamps.
7. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project. Photometric data shall be certified by

a qualified independent testing agency, in IESNA format, based on certified results of laboratory tests of each luminaire type, outfitted with lamps, ballasts and accessories identical to those indicated for the luminaire as applied in the Project.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings:

1. Show details of nonstandard or custom luminaires.
2. Indicate dimensions, weights, method of field assembly, location and size of each field connection, mounting and attachment details, required clearances, components, features and accessories.
3. For custom luminaires, modified luminaires or linear fluorescent luminaires mounted in continuous rows, submit scaled drawings prepared by the manufacturer showing all details of construction, lengths in runs, pendant or power feed locations, accessories, finishes and lists of materials.
4. This Contractor shall provide the manufacturer with accurate field dimensions where required.
5. Include wiring diagrams for power, signal, and control wiring. Wiring diagrams shall detail wiring for luminaires and differentiate between manufacturer installed and field installed wiring.

C. Product Certificates shall be signed by manufacturers of luminaires certifying that products comply with requirements.

D. Pole and Support Component Certificates: Signed by Manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a Professional Engineer.

E. Operation and Maintenance Data shall be provided for luminaires and equipment to include in emergency, operation and maintenance manuals specified in specifications section describing Operations and Maintenance Data.

F. Sample warranty.

G. Special warranties if specified.

H. Product samples complete with housing, trim, specified lamp, and 8' cord with plug shall be submitted if requested.

#### 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 the Authorities Having Jurisdiction, and marked for intended use.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as

defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

- C. Source Limitations: Obtain each type of product from single source from single manufacturer.
- D. Comply with NFPA 70.
- E. Perform work in accordance with NECA "Standard of Installation".

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver luminaires individually wrapped in factory fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.
- B. Handle luminaires carefully to prevent breakage, denting and scouring of the luminaire finish.
- C. Store luminaires in a clean, dry space protected from weather.

### **1.6 COORDINATION**

- A. Coordinate layout and installation of luminaires with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, technology, and partition assemblies.
- B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaires shall have frames that are compatible with the ceiling system.

### **1.7 WARRANTY**

- A. General Warranty for Luminaires: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty for LED arrays and Drivers: Manufacturers standard form in which manufacturer of LED arrays and drivers agrees to replace components that fail in materials or workmanship within specified warranty period.
  - 1. LED arrays: 5 years from date of substantial completion.
  - 2. Drivers: 5 years from date of substantial completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. See Lighting Fixture Schedule on Drawings

## 2.2 GENERAL REQUIREMENTS FOR INTERIOR LUMINAIRES

- 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. Recessed Luminaires: Comply with NEMA LE 4 for ceiling compatibility.
- C. Metal Parts: Free of burrs, sharp corners and edges. Metal work shall be free of tool marks and dents and shall have accurate angles bent as sharply as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
- E. Luminaire hardware to comply with the following material standards: For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel. For bronze luminaires, all hardware shall be stainless steel or bronze, unless otherwise noted.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Safety devices shall be detachable if necessary and shall not interfere with luminaire performance, maintenance or the seating of any luminaire element. Safety device shall not be visible during normal luminaire operation and from normal viewing angles.
- G. Luminaires provided shall have means for disconnection from power source during service, as required in NEC Article 410.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless indicated otherwise:
  - 1. White Surfaces: 85%
  - 2. Specular Surfaces: 90%
  - 3. Diffusing Specular Surfaces: 75%
- I. Reflector cones shall adhere to the following:
  - 1. Cones designed for vertically mounted lamps shall provide a minimum of 45 degree cutoff of lamp and lamp image. Cones designed for horizontally mounted lamps shall provide a minimum of 55 degree cutoff of lamp and lamp image. These shall be no visible lamp flashing in the cone.
  - 2. Plastic material shall not be used for reflector cones, unless otherwise specified.
  - 3. Cones shall not be permanently fastened to the housing of ceiling and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.
  - 4. Trim shall be flush to ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone. Cones with parabolic cross louvers shall be parallel and perpendicular to adjacent walls.
  - 5. Reflector cones shall be uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free from spin marks or other defects.

6. Manufacture cone using the Alzak process. Refer to Luminaire Schedule for cone color and finish, i.e., specular or diffuse requirements. For compact fluorescent luminaires, finish shall eliminate iridescence.
- J. Lenses, Covers, Diffusers and Globes:
1. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized, high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. Lenses shall have uniform brightness throughout the entire visible area.
  2. Glass: Annealed crystal glass unless otherwise indicated.
- K. Adjustable luminaires shall have positive locking devices to fix aiming angle. Luminaires shall be capable of being relamped without adjusting aiming angle.
- L. Luminaires recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.
- M. Provide plaster frame for recessed luminaires mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering luminaires.
- N. For weatherproof or vapor-tight installations, painted finishes of luminaires and accessories shall be weather resistant enamel using proper primers or galvanized and bonded epoxy, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come in contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.
- O. Luminaires for use in areas designated as damp locations shall be suitable gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.
- P. Luminaires shall be free of light leaks while providing sufficient ventilation of lamps to provide the required photometric performance.

### **2.3 GENERAL REQUIREMENTS FOR EXTERIOR LUMINAIRES**

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to Authorities Having Jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Comply with IESNA TM-15-07 Luminaire Classification System for Outdoor Luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Optical assemblies: full cutoff with zero uplight, "dark sky" compliant. LED assemblies shall comply with BUG rating system.
- K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 90 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- M. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Finish: premium 5 stage TGIC polyester powder coat paint.
    - a. Color: See Luminaire Schedule.
- O. Outdoor Wall Mounted Area luminaires:
  - 1. Shall have minimum 52 lumens per watt.
  - 2. No more than 48% of the total luminaire output shall be within the forward 60-80° zone.
  - 3. No more than 3% of the total luminaire output shall be in the forward 80-90° zone.
  - 4. No light at or above horizontal 90-180° zone.

## 2.4 INTERIOR LED LUMINAIRES AND DRIVERS

- A. Interior luminaires:
  - 1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
  - 2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
  - 3. Comply with In-Situ testing for more reliable results.

4. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
5. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
6. LED luminaires shall deliver a minimum of 60 lumens per watt.
7. LED's shall be "Bin No. 1" quality.
8. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
9. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
10. LED color temperatures: CRI> 85, 2700K as noted +/- 145K.
11. LED color temperatures: CRI> 85, 4000K as noted +/- 275K.
12. LED color temperatures: CRI> 85, 5000K as noted +/- 283K.
13. Luminaires shall have internal thermal protection.
14. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
15. Color spatial uniformity shall be within .004 of CIE 1976 diagram.
16. Color maintenance over rated life shall be within .007 of CIE 1976.
17. Indoor luminaires shall have a minimum CRI of 85.
18. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
19. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
20. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers:

1. Power Factor: 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
3. Output operating frequency: 60Hz.
4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
5. Total Harmonic Distortion Rating: 20% Maximum.
6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
7. Primary Current: Confirm primary current with Drawings.
8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
9. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
10. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required
2. The Contractor to ensure that external control equipment is compatible with LED control requirements
3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
4. For control components that are part of overall area control system see Dimming Controls Specifications.

5. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.

## **2.5 EXTERIOR LED DRIVERS AND ARRAYS**

- A. UL 1598 listing.
- B. LED arrays shall have LED's that produce minimum 55 lumens/watt when operated at 350mA.
  1. Lumen Depreciation Data: At 40 deg C ambient, the L70 hours shall be 50,000 at 520 mA driver.
  2. LED color: neutral white, 4100 deg K, CRI of 75.
- C. Drivers shall accept 120 through 480 volts, 50/60 Hz.
- D. The housing shall have an integral thermal management system with extruded aluminum radiation fins and lateral airways.
- E. Comply with IES LM-79-08 and LM-90-08 Approved Methods.
- F. Comply with In-Situ testing for more reliable results.
- G. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

## **2.6 GENERAL REQUIREMENTS FOR LUMINAIRE SUPPORT COMPONENTS**

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- B. Twin-Stem Hangers: 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.
- C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- E. Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.
- F. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- G. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions 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. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Luminaires:
  - 1. Install luminaires level, plumb, and square with ceilings and walls, and secure according to manufacturers written instructions and approved submittal materials, unless otherwise indicated.
  - 2. Comply with NECA 1.
- B. Mounting height indicated from finished floor to bottom of pendant luminaire unless otherwise noted. Verify mounting heights with Architect.
- C. Mounting height indicated to the center of the outlet box for wall mounted luminaires unless otherwise noted. Verify mounting heights with Architect.
- D. Ceiling Grid-Mounted Luminaire Supports:
  - 1. Secure to any required outlet box.
  - 2. Secure luminaire to the ceiling grid tees, using approved fasteners or clips that are UL listed for the application.
  - 3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling grid tees.
- E. Suspended Luminaire Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
  - 5. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 6. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  - 7. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
  - 8. All power feeds shall originate from the same location/end of each run.
- F. Flush-Mounted Luminaire Supports:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaire Support:

1. Attach to junction box securely fastened to building structure or to manufacturer supplied mounting bracket or wall plate. Do not attach luminaires directly to gypsum board.
- H. Provide all necessary hanging or mounting devices and accessories for all luminaires. Verify the types needed for various ceiling conditions. Plaster rings shall be provided where required.
- I. Verify weight and mounting method of all luminaires prior to ordering and provide suitable support. Coordinate with General Contractor for luminaires that require additional blocking or support. Luminaire mounting assemblies shall comply with all local seismic codes and regulations.
- J. Metal decking shall not be pierced for luminaire support.
- K. Refer to architectural reflected ceiling plans for coordination of luminaire locations with mechanical, fire protection, technology and fire safety equipment. Where conflicts occur, coordinate with Architect prior to installing any of the Systems.
- L. In accessible suspended ceilings, luminaire wiring connections, including equipment grounding conductor, is to be through use of 72-inch maximum flexible conduit from a rigidly supported junction box.
- M. Wire per requirements of branch circuit installation. Properly ground each luminaire.
- N. Luminaires located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling. Acoustical ceiling tiles are not acceptable.
- O. Install luminaires with vent holes free of air blocking obstacles.
- P. This Contractor shall be responsible for adjusting aperture flanges or rings on all recessed luminaires to be flush with the finished ceiling. Trim shall completely conceal ceiling opening.
- Q. Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.
- R. Luminaires shall not be secured to ductwork or other systems.
- S. Comply with requirements in Section 260519 - Low-Voltage Electrical Power Conductors and Cables, for wiring connections.

### **3.3 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 0533 - Raceways and Boxes for Electrical Systems. In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### **3.4 CLEANING AND ADJUSTING**

- A. Remove protective plastic covers from luminaires and luminaire diffusers only after construction work, painting and clean-up are completed. Remove, clean, and reinstall all dirty lamps, reflectors and diffusers.
- B. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer for cleaning Alzak reflectors and other surfaces.
- C. Make final adjustment of aimable luminaires and adjustable light settings under the direction of the Architect during a scheduled period of time prior to the completion of the Project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.
- D. Luminaires, reflectors, louvers and accessories which are damaged, blemished, or impregnated with fingerprints shall be replaced at this Contractor's expense. All finishes shall be unmarred upon Project completion.

### **3.5 FIELD QUALITY CONTROL**

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections. Replace or repair luminaire, then retest. Repeat procedure until units operate properly.
- C. Replace all burned out or inoperative LED arrays at time of Substantial Completion, prior to Owner occupancy.
- D. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- E. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
    - a. IES LM-5 "Guide for Photometric Measurements of Area and Sports Lighting Installations".
    - b. IES LM-50 "Guide for Photometric Measurement of Roadway Lighting Installations".
    - c. IES LM-52 "Guide for Photometric Measurements of Roadway Sign Installations".
    - d. IES LM-64 "Guide for Photometric Measurements of Parking Areas".
    - e. IES LM-72 "Directional Positioning of Photometric Data".

**END OF SECTION 26 5000**

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**SECTION 33 1117**  
**SITE DOMESTIC AND FIRE SUPPRESSION WATER DISTRIBUTION PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Provide domestic water and fire service system in accordance with the MODNR Standards, as shown on the Drawings, and as specified herein.
- B. All work on public right of way will be under the direct supervision of the Palmyra Board of Public Works, who shall have final approval of all work and materials necessary to complete this portion of the work.

**1.2 SUBMITTALS**

- A. Product data: If requested by the Owner, within 15 calendar days after the Contractor has received the Notice to Proceed, submit:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Manufacturer's certification of FMRC approval for Fire Service Main materials.
  - 3. Completed Contractor's Underground Main Installation Checklist per FMRC Data Sheet 3-10 Appendix A.

**1.3 REFERENCES**

- A. Standard Specifications shall refer to the MODNR Standard Specifications for Water and Sewer Construction.
- B. *Factory Mutual Engineering and Research Corporation*, (FMRC) 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA. 02062

**PART 2 - PRODUCTS**

**2.1 FIRE SERVICE MATERIALS**

- A. All Fire Service Main Materials and appurtenances shall be Factory Mutual Research Corporation approved and rated for a minimum working pressure of 175 psi.

**2.2 PIPE MATERIALS**

- A. Water pipe shall comply with provisions of Section 40 of the Standard Specifications for the type, class strength coatings and linings of the pipe as shown on the Plans and as described herein:
  - 1. Polyvinyl Chloride (PVC) Pipe:

- a. Conform to latest revisions of AWWA C900.
  - b. Min. Class 200.
  - c. Pressure slip joints with elastomeric seals (gaskets) complying with ASTM F477.
2. Copper Service Pipe:
- a. Type K conforming to ASTM B-88 and B-251.
  - b. Outside diameter conforming to ASTM B-251 Table 2.
  - c. 1 inch diameter unless otherwise noted.

### **2.3 FITTINGS (3" THRU 48")**

- A. Fittings shall comply with provisions of Section 40-2.05A of the Standard Specifications and the following:
1. Cast or Ductile Iron:
    - a. Meeting ANSI A 21.10 (AWWA C110) or ANSI A21.53 (AWWA C153), and ANSI A21.11 (AWWA C111).
    - b. Minimum working pressure same as pipe being joined.
    - c. Cement Lined per ANSI A21.4 (AWWA C104).
    - d. Mechanical Joints unless otherwise noted.
    - e. All mechanical joints shall be mechanically restrained with Megalugs or equivalent

### **2.4 VALVES**

- A. Comply with Section 42 of the Standard Specifications, the latest revisions of AWWA C-509 for Resilient-Seated Gate Valves and the following:
1. Valve stem to be of high tensile bronze or other approved materials with a three (3) O-ring seal and two (2) inch square operating nut.
  2. Valves to open by turning right (clockwise) - *Verify*.
  3. Mechanical Joints unless otherwise noted (MJ x FL for Tapping Valves).
  4. Acceptable Valves:
    - a. Mueller A-2360.
    - b. Kennedy Ken-Seal.
    - c. Approved Equal.

### **2.5 STOPS**

- A. Comply with Article 40-2.06c of the Standard Specifications and the following:
1. Corporation Stops:
    - a. 1" AWWA (Mueller "CC") threaded inlet.
    - b. 1" Flared copper pipe outlet.
    - c. Acceptable Materials:
      - 1) Mueller H-15000.
      - 2) Approved Equal.

2. Curb Stops:
  - a. 1" Inlet and Outlet flared copper.
  - b. Acceptable Materials:
    - 1) Mueller H-15204.
    - 2) Approved Equal.

## 2.6 BOXES AND LIDS

- A. Comply with Section 44 of the Standard Specifications and the following:
  1. Curb Boxes:
    - a. Cast Iron construction, extension type with one piece lid, stationary shut off rod, and arch type box.
    - b. Acceptable Materials:
      - 1) Mueller H-10314 Series.
      - 2) Approved Equal.
  2. Valve Boxes:
    - a. Cast Iron construction.
    - b. Two section screw type with availability to add extensions to increase lengths. Inside diameter of 5 1/4".
    - c. Covers with "WATER" cast into the lid.
    - d. Acceptable Materials:
      - 1) Clow F-2454 and F-2475.
      - 2) Approved Equal.

## 2.7 METER

- A. Comply with applicable provisions of Section 033000.
- B. Meter assembly and casting to be acquired from the Palmyra Board of Public Works. Contractor pay for any associated charges for the assembly and casting.

## 2.8 SADDLES AND SLEEVES

- A. Comply with Section 46 of the Standard Specifications and the following:
  1. Service Saddles:
    - a. Bronze Body Construction.
    - b. 1" AWWA "CC" Threads.
    - c. Mueller Double Strap H-16000 Series of the main size specified.

2. Tapping Sleeves:
  - a. All stainless steel construction with Buna-N ASTM D2200 gasket.
  - b. Verify size of main to be sleeved.
  - c. Acceptable Materials:
    - 1) Ford FAST Stainless Sleeve.
    - 2) Smith Blair Series 663.
    - 3) Approved Equal.

**2.9 FLOWABLE FILL**

- A. Cementitious slurry backfill material containing the following:

1. Material requirements:
  - a. Portland Cement, Type 1:ASTM C150.
  - b. Water: Potable & Clean.
  - c. Fine Aggregate Natural Sand: Washed, Class A Quality, FA 1 gradation per IDOT Standard Specifications.
  - d. Fly Ash: ASTM C-618, Class C or F.
2. Proportioning: Materials shall be proportioned using Mix 1 or 2 as follows:

ITEM	MIX 1	MIX 2
Portland Cement	50 lbs	150 lbs.
Fly Ash – Class C or F	175 lbs	none
Fine Aggregate (saturated surface dry)	2925 lbs	2500 lbs
Water	45-65 gals	35-50 gals
Air Content	none	20-25%

- B. These quantities will yield approximately one cubic yard of the proper consistency. The flowability shall be adjusted within the specified limits to produce desired results. The mixture shall be ready-mixed. Sufficient mixing capacity shall be provided to permit placement without interruption. The mixer drum shall be completely emptied prior to the initial batch to ensure that no additional cement fines are incorporated into the mix.

**2.10 SELECT GRANULAR BACKFILL**

- A. Coarse aggregate material meeting a CA-6 Classification, except the quality may be Class D and up to 15% fines may pass the #200 sieve (i.e. CA-6 Special or B6-X).

**2.11 TRACER WIRE**

- A. Trace wire: Magnetic detectable #12 AWG wire, blue plastic covering.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Before starting excavation, establish location and extent of underground utilities occurring in the work area. Utilities shown on the plans indicate the best knowledge of the Owner with regard to general location and nature of the facilities in the area. They are shown for the convenience of the Contractor and shall not relieve the Contractor of the responsibility to properly investigate and protect the utilities. The Contractor shall remain responsible for damages to existing utilities whether indicated on the plans or not.
- B. The Contractor shall provide Traffic Control and Protection in accordance with, the MODOT Standards, and any required permits for projects involving work on or adjacent to public Rights-of Way.
- C. Erosion Control measures shall be implemented in accordance to MODNR Standards.
- D. The Contractor shall notify the Missouri Once Call System (MOCS) at 1800-344-7483 (DIG-RITE) and the Owner or his/her onsite representative 48 hours prior to start of work.
- E. Field Conditions: Verify location and elevation of existing facilities where connections are to be made. Verify diameter of pipes to be sleeved prior to ordering materials.
- F. The Contractor shall comply with all applicable railroad, street or highway permit conditions including but not limited to purchase of necessary insurance and bonding.

#### **3.2 INSTALLATION**

- A. Excavation and backfilling for the water main and appurtenances shall comply with governing Federal State laws and municipal Ordinances as may be necessary to protect life, property, or the work. In any event, the minimum protection shall conform to the rules and regulations of the Occupational Safety and Health Act (OSHA) Standards for Construction.
- B. Line and Grade: Reference points and bench marks for controlling lines and grades are shown on the Drawings. The Owner will provide field horizontal and vertical control for the Contractor. This control will include centerline and grade stakes at 100 feet intervals and location of all tees, valves, fittings and connections.
- C. Depth of Cover: The water main shall be laid at the elevations shown on the plans or at a minimum of 4'-6" of cover over the top of the pipe.
- D. Rock Excavation: Rock excavation shall consist of the excavation of boulders (1/2 cu yd) in volume or greater and all rock in ledges, bedded deposits and conglomerate deposits exhibiting the physical characteristics of rock which requires continuous use of pneumatic tools or drilling and blasting for removal. Blasting to remove the rock may be used only with written permission of the City Engineer.
- E. Fire Service Main piping and appurtenances shall be installed in accordance with FMRC *Loss Prevention Data Sheet 3-10* and the specifications herein. In case of conflict the Data Sheet shall govern.

F. Pipe Installation:

1. The pipe shall be installed in strict accordance with the manufacturer recommendations, Section 41 of the Standard Specifications and the following.
2. Installation of PVC pipe shall comply with the requirements of ASTM D2774.
3. The trench width shall be in accordance with Article 20-2.03 of the Standard Specifications and the attached "Conduit Installation" detail.
4. The trench bottom shall be constructed relatively smooth and free from large stones, large dirt clods and any frozen material prior to placement of the pipe.

G. Bedding and Backfill:

1. The pipe shall be uniformly and continuously supported over its entire length on stable soils. Unsuitable soils shall be removed and replaced in accordance with Article 2020-4.05. Bell locations shall be excavated to provide uniform support.
2. Initial backfill shall consist of placing and hand compacting suitable trench material beneath and up to the center of the pipe. The initial backfill of PVC pipe shall include placement of select backfill materials (maximum dimension 1/2" or less) in 6" lifts to 12 inches over the top of the pipe in accordance with ASTM D2774.
3. The remainder of the backfill shall be in accordance with Article 20-4.06B of the Standard Specifications and as follows:
  - a. **Case I:** (Trench Material - No Compaction). Shall be used unless otherwise noted on the plans.
  - b. **Case II:** (Not Used).
  - c. **Case III:** (Compacted Aggregate). In areas which now or in the foreseeable future could be subject to vehicular traffic or is beneath pavements or sidewalks "Select Granular Backfill" material shall be used. When PVC pipe is used aggregate materials complying with ASTM D2774 (less than 3/4" particle size) shall be used for the initial backfill material above the centerline of the pipe and included in the calculation of the Select Granular Backfill quantity. The aggregate shall be mechanically compacted to a minimum 90% Standard Proctor Density. (ASTM D698).
  - d. **Case IV:** (Jetting or Watersoaking - Not Allowed).
  - e. **Case V:** (Trench Material - Hydrohammered). In addition to the requirements of Article 20-2.21B (5) the backfill material shall be compacted by means of a hydrohammer (min. 2100 ft-lb impact rating) equipped with a compacting plate. One complete pass over the full width of the trench shall be performed. The hydrohammer shall not be used directly over utility lines or until a minimum of 3 feet of cover is over the pipe. After compacting the trench shall be brought to grade and reshaped to the surrounding ground surface. No additional payment will be allowed for hydrohammering the backfill.
4. Flowable Fill: When specified or at the Contractor's option, flowable fill material shall be used in lieu of Select Granular Backfill. Use only ready-mix batching and transport in an agitating truck. The mix shall be self leveling and placed in excavated areas using the excavated walls as forms. Unsuitable material in the bottom or sides of the excavation shall be removed unless otherwise approved by the Engineer/Architect.

H. Testing: The pipe and appurtenances shall be tested in accordance with Section 41-2.14 of the Standard Specifications.

I. Disinfecting: The pipe and appurtenances shall be disinfected in accordance with Section 41-2.15 of the Standard Specifications and the following:

1. The Contractor shall take and deliver bacteriological samples to the Palmyra Board of Public Works facility at 301 S. Main St., Palmyra, Missouri, for analysis. Cost for sampling and analysis required, will be at the expense of the Contractor.

### **3.3 SURFACE RESTORATION**

- A. Surface restoration shall comply with Section 21 of the Standard Specifications, details in the plans and Project Documents and the following.
- B. Temporary Surface when specified shall consist of a minimum:
  1. 8" of CA-6 Coarse Aggregate on Aggregate surfaced roadways.
  2. 8" of CA-6 Coarse Aggregate Base with 2" of Bituminous patch mix surface on Bituminous or PCC pavements.
- C. Permanent Surface:
  1. All pavements shall be sawed at least 1/2 the pavement thickness prior to removal and replaced as shown in the plans. Damage to the remaining pavement edges prior to replacement shall be resawed, removed and replaced at the Contractor's expense.

### **3.4 FIELD QUALITY CONTROL**

- A. The Owner will provide testing services of a soils engineer and/or independent laboratory for this project.
- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the A/E.
- C. Testing Requirements:
  1. Standard Proctor Density/Moisture (ASTM D 698):
    - a. 1 per the in situ fill material.
    - b. 1 per each source of offsite fill material.
  2. Field density/moisture tests (ASTM D6938):
    - a. Trenches: 1 per 100 foot of trench per 12" lift, if trench is less than 200 foot in length, 1 test per trench per 12" lift..

### **3.5 GUARANTEE**

- A. The Contractor shall guarantee that all material and work on the watermain, the backfill, and all related appurtenances, including the restoration of all street pavements, shall be free from defects of materials and labor and remain in good condition for a period of one (1) year from the date of Letter of Acceptance of the project.

**END OF SECTION 33 1117**

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**SECTION 33 4100  
STORM UTILITY DRAINAGE PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Provide domestic water and fire service system in accordance with the MODNR Standards, as shown on the Drawings, and as specified herein.
- B. All work on public right of way will be under the direct supervision of the Palmyra Board of Public Works, who shall have final approval of all work and materials necessary to complete this portion of the work.

**PART 2 - PRODUCTS**

**2.1 PIPE MATERIALS FOR SEWERS**

- A. The following materials shall be used when specified:
  - 1. Polyvinyl Chloride (PVC) Pipe:
    - a. Conforming to ASTM D 1784 "Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Compounds" and the latest revisions of ASTM D 2241 or 3034 (SDR 26) as specified. Include the appropriate ASTM Designations and Cell Classification Numbers (12454-B or 12454-C) or other approved classifications) or ASTM D 1784 "Rigid Poly (Vinyl Chloride) and shall be rated Schedule 40 pipe.
  - 2. Corrugated HDPE Smooth Interior Pipe:
    - a. HDPE Smooth Interior Pipe does not have to meet the AASHTO M 294 Section 6 – Materials: Requiring pipe and fittings be made of virgin PE compounds. A percentage of recycled material may be utilized. All remaining requirements as set forth in AASHTO M 294 shall be met or exceeded.
  - 3. Joints:
    - a. PVC Pipe joints shall be flexible elastomeric seals as noted:
      - 1) ASTM D 3212.
      - 2) ASTM D 2855.
      - 3) ASTM F 477.
- B. Pipe Drains, Underdrains and French Drains materials shall comply MODNR Specifications for the type, class, and size of pipe as shown on the Plans and as described herein:
- C. Manholes, Inlets, and Drainage Structure materials shall comply with MODNR Specifications for the type of structure, frame and grate or lid and Nyloplast drain basins and grates or equal, as shown on the Plans and as described herein:
- D. End Sections shall be in accordance with MODNR Specifications for the type and size specified on the plans.
- E. Grating for Reinforced Concrete End Sections shall conform MODNR and MODOT Standards herein included. Shop Drawings of grate sizes not shown on the Standard shall be provided to the Engineer prior to ordering.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION & LAYOUT**

- A. Before starting excavation, establish location and extent of underground utilities occurring in the work area. Utilities shown on the plans indicate the best knowledge of the Owner with regard to general location and nature of the facilities in the area. They are shown for the convenience of the Contractor and shall not relieve the Contractor of the responsibility to properly investigate and protect the utilities. The Contractor shall remain responsible for damages to existing utilities whether indicated on the plans or not.
- B. The Contractor shall notify the Missouri Once Call System (MOCS) at 1800-344-7483 (DIG-RITE) and the Owner or his/her onsite representative 48 hours prior to start of work.
- C. Field Conditions: Verify location and elevation of existing facilities where connections are to be made

#### **3.2 INSTALLATION**

- A. Storm sewer pipe and structures shall be installed in accordance with applicable MODNR Specifications.
- B. Excavation and backfilling for sewers, manholes, structures and appurtenances, shall comply with governing Federal and State laws, and Local Ordinances as may be necessary to protect life, property, or the work. In any event, the minimum protection shall conform to the rules and regulations of the Occupational Safety and Health Act (OSHA) Standards for Construction.
- C. Backfilling Trenches:
  - 1. Backfill above the center line of the pipe shall be in accordance with Article 550.07 of the Standard Specifications, as shown on the Drawings.
  - 2. Aggregate trench backfill shall be placed beneath and within 2 ft. of areas of proposed pavements, walks, footings, foundations, slabs or other structures.
  - 3. When trench backfill material is specified, compaction of the backfill shall be 95% of the Standard Proctor Density (ASTM D698) method, for the type of aggregate used.
- D. Riprap:
  - 1. Riprap shall be in accordance with MODNR Standards except B and C quality aggregate will be accepted.
  - 2. Filter fabric or a bedding layer will not be required unless specified on the plans.
  - 3. When the gradation is not specified the minimum thickness shall be 12" and the gradation shall be 4.
- E. Manholes And Water Valves:
  - 1. Final adjustment of manholes frames and valve boxes in pavement areas shall be completed after the binder course has been placed and prior to placement of the surface course. The adjustments shall be in accordance with MODNR Standards.  
Bituminous patching material shall be temporarily placed around any manhole lid or water valve above the binder layer until the bituminous surface is placed.

#### **3.3 FIELD QUALITY CONTROL**

- A. The Owner will provide testing services of a soils engineer and/or independent laboratory for this project.

- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the A/E.
- C. Testing Requirements:
  - 1. Standard Proctor Density/Moisture (ASTM D 698):
    - a. 1 per the in situ fill material.
    - b. 1 per each source of offsite fill material.
  - 2. Field density/moisture tests (ASTM D6938):
    - a. Trenches: 1 per 100 foot of trench per 12" lift, if trench is less than 200 foot in length, 1 test per trench per 12" lift..

### **3.4 GUARANTEE**

- A. The Contractor shall guarantee that all material and work on the storm sewer, the backfill, and all related appurtenances, including the restoration of all street pavements, shall be free from defects of materials and labor and remain in good condition for a period of one (1) year from the date of Letter of Acceptance of the project.

**END OF SECTION 33 4100**

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**SECTION 33 4101  
SANITARY SEWERAGE SYSTEM**

**PART 1 – GENERAL**

**1.1 SUMMARY**

- A. Provide sanitary sewerage system in accordance with the MODNR standards, as shown on the Drawings, and as specified herein.
- B. All work on public right of way shall also be in accordance with the rules and regulations of the Palmyra Board of Public Works.

**PART 2 – PRODUCTS**

**2.1 PIPE MATERIALS FOR SEWERS**

- A. Sewer pipe shall comply with MODNR Standard Specifications for the type, class, strength, coatings and linings of the pipe as shown on the Plans and as described herein:
  - 1. Polyvinyl Chloride (PVC) Pipe 4" to 15" diameter:
    - a. Dimensions of pipe and fittings shall conform to ASTM D3034.
    - b. Minimum acceptable Standard Dimension Ratio (SDR) shall be 26.
- B. Joints:
  - 1. PVC Pipe joints for ASTM 3034 and ASTM 679 pipe shall be flexible elastomeric seals per ASTM D 3212 or solvent welded joints per ASTM D 2855 for 4" and 6" only.
  - 2. PVC Pipe joints for AWWA C905 pipe shall be flexible elastomeric seals per ASTM D 3139.
- C. Manholes:
  - 1. Manholes shall be constructed of precast units with plastic coated steps, in accordance with MODNR Standard Specifications, and details in the Drawings. Pipe stubs when specified for future connections shall consist of a one-foot section of belled pipe of the specified diameter inserted in a watertight connection and an airtight plug.
- D. Concrete:
  - 1. Concrete for structures and incidental items shall be preapproved by the Engineer and have a compressive strength of 3500 psi @ 14 days.
- E. Granular Foundation:
  - 1. Granular foundation material shall be gravel or crushed stone sized primarily within a 1" to maximum 3" range. Quality shall consist of sound durable aggregate particles reasonably free of objectionable deleterious materials.

F. Bedding, Haunching and Initial Backfill :

1. Bedding and haunching material shall be a coarse gravel or coarse sand, in accordance with ASTM D2321 Class II or crushed stone or crushed gravel, in accordance with ASTM D2321 Class IB, unless otherwise specified. Acceptable Class II gradation includes CA-6, CA-9, CA-13, and CA-16. Acceptable Class IB gradation includes CA-6, CA-9, CA-13, and CA-16.
2. Where groundwater flow is encountered or when specified in the plans, well graded bedding, haunching shall consist of a Class 1B material as per ASTM D 2321. Acceptable Class IB material includes:
  - a. CA-9, CA-13, and CA-16.
3. For flexible thermoplastic pipe (i.e. PVC, etc), initial backfill at least twelve (12) inches above the top of the pipe shall be placed utilizing the same type of material used for haunching.

G. Select Granular Backfill:

1. Select granular backfill shall be a CA-6 material, except the quality may be Grade D and up to 15% fines passing the #200 sieve will be allowed (CA-6 Special or B6X).

**PART 3 - EXECUTION**

**3.1 SURFACE CONDITIONS**

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- B. Field Measurements - Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

**3.2 INSTALLATION**

- A. Excavation and backfilling for sewers, collection lines, manholes, structures and appurtenances, shall comply with governing Federal State laws and municipal Ordinances as may be necessary to protect life property or the Work. In any event, the minimum protection shall conform to the rules and regulations of the Occupational Safety and Health Act (OSHA) Standards for Construction.
- B. Connections of dissimilar types of pipe when joined outside of a manhole or other structure shall be joined with suitable adapters, such as:
  1. Fernco Flexible Coupling, Fernco, Inc. (Davison, Michigan).
  2. Flexi-Seal Coupling, Mission Rubber Co. (Corona, California).
  3. Approved equal.

C. Foundations and Bedding:

1. All sewer pipe shall be laid on an aggregate bedding, having a minimum thickness of 4 inches below the pipe and extending to the midpoint of the pipe as shown on the Drawings.
2. Compaction requirements for foundation, bedding and haunching shall be based upon the material utilized.

D. Tees and Laterals:

1. Unless otherwise specified, tees and laterals shall be of the same type and strength material as the main sewer pipe.
2. Lateral pipes and connecting tees or saddles shall be six-inch unless otherwise specified and shall be installed at locations shown on the Plans. Each Lot shall be served by a lateral sewer pipe installed to the property line.
3. Sewer laterals shall cross streets at right angles to the street centerline. Trenching and backfilling laterals shall comply with the same requirements as the main sewer pipe it joins. Open ends of laterals or tees shall be closed with air tight plugs which can readily be removed at a later date without breaking the lateral pipe or tee.
4. The Contractor shall be responsible for installing laterals to the depth shown on the Plans.
5. Contractor shall locate tees and ends of laterals by field measurements from manholes and main sewer and submit a record of locations to the Engineer.

E. Backfilling Trenches:

1. After sewers are laid and bedded in an open cut, the trench shall be backfilled to the original ground surface or street pavement. Unless otherwise permitted by the regulatory authority, not more than three hundred (300) feet of completed pipe shall be left without backfill.
2. In all types of backfill, trench shields, sheeted sections and bracing shall in no case be withdrawn before the trench is sufficiently filled to prevent personal injury, or collapse of trench walls, banks, road surfaces, adjacent utility structures, sidewalks or other property, public or private.
3. When PVC pipe is used, select granular initial backfill shall be placed as specified in Section 2.1 F. of these specifications.
4. The Contractor shall utilize the following methods of final backfill, at the locations shown on the Drawings and as specified herein.

a. TYPE 1:

- 1) Type 1 backfill shall be strictly limited to those locations not now or likely to be in the foreseeable future subject to vehicular traffic. Select excavated material, free from clods or stones shall be placed from the top of the initial backfill to the surface. The trench surface shall be mounded at least 12 inches above existing grade. The trench will be allowed to settle for a period not less than three months, unless otherwise directed by the Engineer. The trench surface shall be leveled and reshaped to the surrounding grade at the end of the settlement period.

b. TYPE 2:

- 1) Type 2 backfill when specified shall be utilized in areas which now or in the foreseeable future could be subject to vehicular traffic. Select excavated material, free from clods or stones shall be placed above the initial backfill in 12 inch compacted lifts, unless modified by the Engineer, to a minimum of 90 percent of the maximum dry unit weight (density) as determined by ASTM D-698 Standard Proctor test.
- 2) The Engineer, at the Contractor's request, will determine the optimum moisture content of the backfill material for conducting the compaction tests.

The Contractor shall place and compact the material within a range of 3 percent below to 5 percent above the material's optimum moisture content. Should the material not be within this range, the Contractor shall dry or add water to the material to comply with the requirement, or with the approval of the Owner shall waste the unsuitable material onsite and utilize other onsite suitable material, all of which will be at the Contractor's expense.

c. TYPE 3:

- 1) Type 3 backfill shall be utilized unless otherwise specified in areas which now or in the foreseeable future could be subject to vehicular traffic. Coarse aggregate material shall be placed and mechanically compacted in 12-inch lifts to the pavement subbase elevation. The coarse aggregate material shall be mechanically compacted to 90% Standard Proctor Density. Jetting or water soaking will not be allowed.

F. The following tests and inspection of sanitary sewers as specified in Section 31-1.11 of the Standard Specifications shall be performed:

1. Exfiltration of air under pressure:

- a. After the construction of the sewer mains, manholes and laterals, onto the sanitary system, the municipality shall perform a low pressure air test. Personnel will perform the air test from manhole to manhole.
- b. Air leakage test results shall not be less than the time per inch of pipe diameter per length of sewer pipe as specified in the table entitled "Air Test Table.", Article 31-1.11C.
- c. If the section of sewer fails to pass the test, it shall be the Contractor's responsibility to locate the problems and make the necessary repairs.
- d. Following the successful passage of a low pressure air test, the City will immediately assume responsibility for the operation and maintenance of the sewers with the exception of settlement of the sewer trenches.

2. For flexible thermoplastic pipe, a deflection test shall be performed in accordance with Section 31-1.11 of the Standard Specifications (Contractor Performed).

3. Manholes shall be air tested for leakage by the Contractor in accordance with ASTM C1244-93, Standard Test Method for Concrete Sewer Manholes by the Negative Pressure (Vacuum) Test or most recent approved.

4. Manhole preparation:

- a. Plug all lift holes.
- b. Temporarily plug all pipes entering the sewer manhole, taking care to securely brace the pipes and plugs to prevent them from being drawn into the sewer manhole.

5. Test procedure:

- a. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
- b. A vacuum of 10 in. Hg shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 in. Hg.

- c. The manhole shall pass if the time for the vacuum reading to drop from 10 in. Hg to 9 in. Hg meets or exceeds the values indicated in Table 1 of ASTM Designation C 1244.

**TABLE 1 from ASTM Designation: C 1244**  
**Minimum Test Times for Various Manhole Diameters in Seconds**

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
	Time, in seconds								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	30	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

- d. If the manhole fails the test, the Contractor shall make necessary repairs and retest the manhole. Repairs must be repeated until the manhole passes the test.
- e. If manhole joint sealants are pulled out during the vacuum test, the manhole must be disassembled and the joint sealants replaced.
- f. Manholes will also be subject to visual inspection with all visual leaks being repaired.
6. Sewer Pipe and Water Main Separation:
- a. Water mains and water service lines shall be protected from sewer lines in accordance with MODNR Standard Specifications.
- G. Manholes and Water Valves:
1. Manhole frames and valve boxes in proposed bituminous pavement areas shall be initially constructed to the binder course elevation. The frame or box shall be adjusted to finish grade prior to placement of the surface course. The adjustments shall be in accordance with MODNR Specifications.

**3.3 FIELD QUALITY CONTROL**

- A. The Owner will provide testing services of a soils engineer and/or independent laboratory for this project.

- B. Upon completion of each test and/or inspection, promptly distribute copies of test or inspection reports to the A/E.
- C. Testing Requirements:
  - 1. Standard Proctor Density/Moisture (ASTM D 698):
    - a. 1 per the in situ fill material.
    - b. 1 per each source of offsite fill material.
  - 2. Field density/moisture tests (ASTM D6938):
    - a. Trenches: 1 per 100 foot of trench per 12" lift, if trench is less than 200 foot in length, 1 test per trench per 12" lift..

### **3.4 GUARANTEE**

- A. The Contractor shall guarantee that all material and work on the sanitary system, the backfill, and all related appurtenances, including the restoration of all street pavements, shall be free from defects of materials and labor and remain in good condition for a period of one (1) year from the date of Letter of Acceptance of the project.

**END OF SECTION 33 4101**