

PROJECT MANUAL



NEW HANOVER COUNTY STAR CENTER

1605 ROBIN HOOD ROAD
WILMINGTON, NC 28401

BID SET

AUGUST 21, 2024




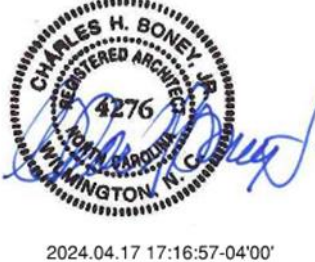

101 N 3RD ST
STE 500,
WILMINGTON, NC 28401
PHONE: (910) 790-9901

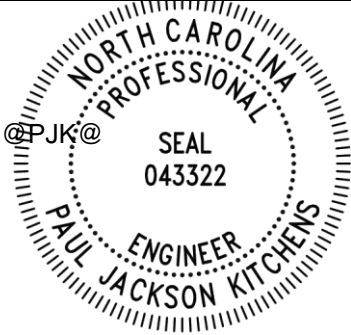
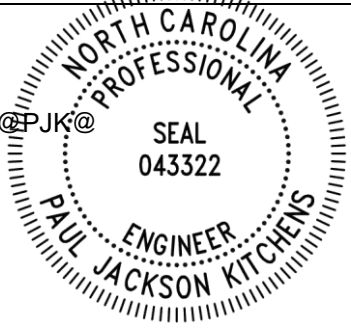
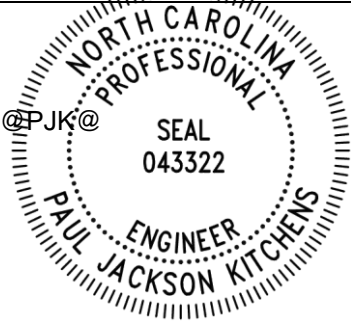
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DOCUMENT 000107 – PROJECT DIRECTORY AND SEALS PAGES

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AIA® Document A701® – 2018

Instructions to Bidders

for the following Project:

(Name, location, and detailed description)

New Hanover County STAR Center
1601 Robin Hood Road
Wilmington, North Carolina 28401

Scope of Work includes exterior and interior renovations to an existing building.

THE OWNER:

(Name, legal status, address, and other information)

New Hanover County
200 Division Drive
Wilmington, NC, 28401

THE ARCHITECT:

(Name, legal status, address, and other information)

LS3P Associates LTD
101 N 3rd Street, Suite 500
Wilmington NC 28401

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- 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™–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.)

§ 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.)

§ 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.)

§ 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.)

§ 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 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.)

§ 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.)

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

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

.6 Specifications

| Section | Title | Date | Pages |
|----------------|--------------|-------------|--------------|
|----------------|--------------|-------------|--------------|

.7 Addenda:

| Number | Date | Pages |
|---------------|-------------|--------------|
|---------------|-------------|--------------|

.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:

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

Supplementary and other Conditions of the Contract:

| Document | Title | Date | Pages |
|-----------------|--------------|-------------|--------------|
|-----------------|--------------|-------------|--------------|

.9 Other documents listed below:

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

Document 000007 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS**SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL**

The following supplements modify AIA Document A701 - 1997 Instructions to Bidders. Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of Instructions to Bidders shall remain in effect.

ARTICLE 2 BIDDER'S REPRESENTATIONS*Add §2.1.3.1:*

§2.1.3.1 The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included the cost of such fees, permits, and requirements not otherwise specifically indicated as provided by the Owner, in the submitted bid.

Add §2.1.5:

§2.1.5 The Bidder is properly licensed Contractor in accordance with the General Statutes of the State of North Carolina and meets qualifications indicated in the Bidding Documents.

ARTICLE 3 BIDDING DOCUMENTS**§3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS***Add §3.2.2.1:*

§3.2.2.1 Submit requests for interpretation of the bidding documents in writing using "Bidder's Request For Interpretation".

§3.3 SUBSTITUTIONS*Add §3.3.2.1:*

§3.3.2.1 Submit substitution requests in writing using "Bidder's Request For Substitution," properly completed and signed. The Architect will review requests for substitution of comparable products when submitted by Prime Bidders. Submit requests to the Architect no later than 10 days prior to the date established for receipt of bids. Attach a copy of the respective specification section with point-by-point compliance or variance, and accompanied by sufficient independently certified test data, code and third party approvals, product samples, and additional information needed to support the request. Architect's acceptance of products on previous projects does not guarantee acceptance on this Project. Undocumented requests will not be reviewed. Approval of requests is by Addendum only.

§3.4 ADDENDA

Delete §3.4.3 and replace with the following:

§3.4.3 Addenda may be issued at any time prior to the receipt of bids.

Add §3.4.4.1:

§3.4.4.1 The Owner may elect to waive the requirement for acknowledgement of received Addenda in §3.4.4 if:

.1 Information received as part of the bid indicates that the bid as submitted reflects modifications to the Bidding Documents included in an unacknowledged Addendum, or

.2 Modifications to the Bidding Documents in an unacknowledged Addendum do not, in the opinion of the Owner, affect the Contract Sum or Contract Time.

ARTICLE 4 BIDDING PROCEDURES**§ 4.1 PREPARATION OF BIDS**

Add §4.1.8:

§ 4.1.8 The Bid shall include Unit Prices when called for by the Bidding Documents. The Owner may elect to consider Unit Prices in the determination of award. Unit Prices accepted by the Owner will be incorporated in the Contract.

Add §4.1.9:

§4.1.9 The 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.

Add §4.1.10:

§4.1.10 Bids shall include sales and use taxes. Contractors shall show separately with each monthly payment application the sales and use taxes paid by them and their subcontractors in the form indicated. Reimbursement of sales and use taxes, if any, shall be applied for by the Owner for the sole benefit of the Owner.

Add §4.1.11:

§4.1.11 Each Bid shall be accompanied by listing of Minority Businesses that will be utilized on the project and affidavit documenting good faith efforts to encourage and facilitate minority participation in the project.

§4.1.11.1 A Minority person, for purposes of this Contract, is a citizen or lawful permanent resident of the United States who is Black, Hispanic, Asian-American, American Indian or female.

§4.1.11.2 A Minority Business, for purposes of this Contract, is a business in which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority person and of which the management and daily business operations are controlled by one or more of the minority person who own it.

§4.3 SUBMISSION OF BIDS

Add §4.3.1.2:

§4.3.1.2 Include Bidder's State of North Carolina Contractor License Number on the face of the sealed bid envelope.

§4.4 MODIFICATION OR WITHDRAWAL OF BIDS

Add the following to §4.4.2:

§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 by-laws, specifically empowered by the Bidder's charter or similar legally binding document acceptable to the 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 the Owner at the time of seeking modifications or withdrawal of Bid.

§4.4.2.2 The 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.

Add §4.5:

§4.5 SUBCONTRACTORS, SUPPLIERS, AND MANUFACTURERS LIST BID SUPPLEMENT

§4.5.1 Provide a list of major subcontractors, suppliers, and manufacturers furnishing or installing products on forms provided no later than 2 business days following Architect's request. Include those entities providing work totaling 3 percent or more of the bid amount. Do not change subcontractors, suppliers, and manufacturers from those submitted without approval of Architect.

ARTICLE 5 CONSIDERATION OF BIDS

§5.2 REJECTION OF BIDS

Add §5.2.1:

§5.2.1 The Owner reserves the right to reject a Bid based upon the Owner's and Architect's evaluation of qualification information submitted following opening of bids. The 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 the 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.

ARTICLE 6 POST-BID INFORMATION

§6.1 CONTRACTOR'S QUALIFICATION STATEMENT

Add §6.1.1:

§6.1.1 Submit Contractor's Qualification Statement no later than 2 business days following Architect's request.

§6.3 SUBMITTALS

Add §6.3.1.4:

§6.3.1.4 Submit information requested in **§6.3.1.1**, **§6.3.1.2**, and **§6.3.1.3** no later than 2 business days following Architect's request.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 BOND REQUIREMENTS

Add §7.1.1.1:

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

§ 7.2 TIME OF DELIVERY AND FORM OF BONDS

Delete the first sentence of §7.2.1 and insert the following:

"The Bidder shall deliver the required bonds to the Owner not later than 10 days after the date of the notice to award and not later than the date of execution of the Contract, whichever occurs first. The Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default."

Delete §7.2.3 and insert the following:

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

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Add §8.1:

§8.1 EXECUTION OF THE CONTRACT

§8.1.1 Subsequent to the notice 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 the Owner through the Architect, in such number of counterparts as the Owner may require.

§8.1.3 Unless otherwise indicated in the Bidding Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement or the date that the Bidder is obligated to deliver the executed Agreement and required bonds to the Owner.

§8.1.2 The Owner may deem 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 a default.

§8.1.4 In the event of a default, the 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.

Add §8.2:

§8.2 TIME OF COMMENCEMENT AND COMPLETION

§8.2.1 The Contractor shall commence Work within 10 days following execution of the Contract, or when notified in writing to proceed, and shall complete the Work within the Contract Time.

END OF SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

BIDDER'S REQUEST FOR INFORMATION FORM

Project: New Hanover County STAR Center

LS3P Project #7405-230775

To: LS3P Associates Ltd.
101 N. Third Street, Suite 500
Wilmington, NC 28401

Requested By: _____
Firm: _____
Phone No.: _____
Date: _____
nd Paragraph No.: _____
Related Drawings/Details: _____

E-Mail: daniellaayers@LS3P.com

Attn: Daniella Ayers

Bidder's Inquiry:

Signed:

Response:

Architect's response will be issued by formal Addendum.

Signed:

Date:

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SECTION 004113 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

A. Bidder:

B. Bid Date: _____

C. Project Name: **New Hanover County STAR Center**

D. Project Location: **1605 Robinhood Road**

E. **Wilmington, NC**

F. Owner: **New Hanover County**

G. Architect: **LS3P**

H. Architect Project Number: **7405-230775**

1.2 CERTIFICATIONS AND BASE BID

1.3 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 LS3P [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
(\$_____)

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 **ten (10)** days after a written Notice of Award, if offered within **sixty (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
(\$_____)

1.5 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.

1.6 SUBCONTRACTORS AND SUPPLIERS

A. The following companies shall execute subcontracts for the portions of the Work indicated:

B. Name License No.

C. Plumbing _____

D. Mechanical _____

E. Electrical _____

1.7 ALLOWANCES

A. The undersigned further agrees that the Base Bid stated above includes the following allowances in accordance with Section 012100 "Allowances":

B. Allowance No. 1: Testing & inspections:

C. _____ DOLLARS (\$_____)

D. Allowance No. 2: Unit cost allowance:

E. _____ DOLLARS (\$_____)

F. Allowance No. 3: Contingency allowance:

G. _____ DOLLARS (\$_____)

1.8 ALTERNATES

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates, as described in Section 012300 "Alternates", are accepted by Owner. Amounts listed for each alternate include cost of related coordination, modification, or adjustment. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE".

B. Alternate No. 1: New Entrance canopy

C. Add/Deduct _____ DOLLARS
\$ _____)

D. Alternate No. 2: Decorative Fence at RHA Courtyard

E. Add/Deduct _____ DOLLARS
\$ _____)

F. Alternate No. 3: Eliminate Courtyard Fence at LINC side

G. Add/Deduct _____ DOLLARS
_____)

H. Alternate No. 4: Metal Roof Panels - Recoating

I. Add/Deduct _____ DOLLARS
\$ _____)

J. Alternate No. 5: Sink Vanities at RHA Bathrooms

K. Add/Deduct _____ DOLLARS
\$ _____)

1.9 TIME OF COMPLETION

A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect, and shall fully complete the Work within **48 weeks or 336 calendar days**.

1.10 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 _____.
- 5.
- 6.
- 7.
8. Continued, Next Page.

1.11 CONTRACTOR'S LICENSE

- A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in **North Carolina**, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.12 SUBMISSION OF BID

- A. Respectfully submitted this ____ day of _____, **2024**.
- B. Name of Bidder: _____
(Company)
- C. By: _____
(Signature) (Typed Name)
- D. Title: _____
(Owner/Partner/President/Vice President).
- E. Address of Bidder: _____
- F. City, State, Zip: _____
- G. Bidder's Phone No.: _____
- H. License No.: _____
- I. Federal ID No.: _____ (Affix Corporate Seal Here, Inked or Electronic)
- J.
- K.
- L. Witness:
- M. _____
- N. (Proprietorship or Partnership)
- O. Attest:
- P. By: _____
- Q. Title: _____

END OF DOCUMENT 004113

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DOCUMENT 000011 - BID SUBMITTAL CHECKLIST

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Prime Contract: _____.
- C. Project Name: <Insert Project name>.
- D. Project Location: <Insert Project location>.
- E. Owner: <Insert name of Owner>.
- F. Architect: <Insert name of Architect>.

1.2 BIDDER'S CHECKLIST

- A. In an effort to assist the Bidder in properly completing all documentation required, the following checklist is provided for the Bidder's convenience. The Bidder is solely responsible for verifying compliance with bid submittal requirements.
- B. Attach this completed checklist to the outside of the Submittal envelope.
 - 1. Used the Bid Form provided in the Project Manual.
 - 2. Prepared the Bid Form as required by the Instructions to Bidders.
 - 3. Acknowledged on the Bid Form the Addenda received.
 - 4. Acknowledge and Completed the MBE Forms, including Affidavit A or Affidavit B.
 - 5. Attached to the Bid Form: Bid Supplement Form - Alternates.
 - 6. Attached to the Bid Form: Bid Bond OR a certified check for the amount required.
 - 7. Bid envelope shows name and address of the Bidder.
 - 8. Bid envelope shows the Bidder's North Carolina Contractor's License Number.
 - 9. Bid envelope shows name of Project being bid.
 - 10. Bid envelope shows time and day of Bid Opening.
 - 11. Verified that the Bidder can provide North Carolina executed Performance Bond and Labor and Material Bond.
 - 12. Verified that the Bidder can provide North Carolina Certificates of Insurance in the amounts indicated.
 - 13.
 - 14. **END OF DOCUMENT 004393**

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New Hanover County
Minority and/or Women Business Enterprise
(M/WBE) Program



Construction Guidelines and Affidavits

These instructions shall be included with each bid solicitation.

New Hanover County
Minority and/or Women Business Enterprise Program

Construction Guidelines for M/WBE Participants

Policy Statement

It is the policy of New Hanover County that minority businesses, as defined by North Carolina General Statute 143-128 have maximum opportunity to participate in the performance of contracts and subcontracts funded in whole or in part with public funds. This includes all aspects of the County’s contracting and procurement programs, including but not limited to construction projects, supplies and materials, as well as professional and personal service contracts.

Goals and Good Faith Efforts

Bidders responding to this solicitation shall comply with the M/WBE program by making Good Faith Efforts to achieve the following aspiration goals for participation.

| PROJECT | MBE | WBE |
|---------|-----|-----|
| | 6% | 4% |

Bidders must submit M/WBE information with their bids on the forms provided. This information will be subject to verification by the County prior to contract award. Firms qualifying as “WBE” must be designated as ‘women-owned business” by NC Department of Historically Underutilized Businesses (NCHUB). Firms qualifying as “MBE” for the County’s goals must be certified in one of the other categories (i.e.: Black, Hispanic, Asian American, American Indian, Disabled, or Socially and Economically Disadvantaged). Those firms who are certified as both a “WBE” and “MBE” may only satisfy the “MBE” requirement. **Each goal must be met separately. Exceeding one goal does not satisfy requirements for the other.**

In order for companies to count toward minority participation on building construction projects they must be currently certified as a HUB. You can verify that firms are certified using the HUB Office’s Search for Vendor Information page.

An internal database of firms who have expressed interest to do business with the County is available at <https://finance.nhcgov.com/purchasing-solicitation/minority-women-business-enterprise-program/>. Please note that the HUB status of these firm **MUST** be verified by checking the HUB database Search for Vendor Information page .

The NC Department of Transportation (NC DOT) and the NC Office for Historically Underutilized Businesses (HUB Office) have an agreement that allows companies certified through NC DOT’s Disadvantaged Business Enterprise (DBE) program to use a simplified application process to become certified as a Historically Underutilized Business (HUB).

Firms that are already DOT DBE and want to be HUB certified would submit a completed one page DOT DBE / NC HUB Reciprocity application, a copy of their DBE approval letter, a copy of proof of

citizenship or permanent residence, and proof of ethnicity / disability (if applicable) to the NC HUB Office.

Please note: A contractor may utilize any firm desired; however, in order to count towards the County's minority participation goals, all MWBE vendors who wish to do business as a minority or female must be certified by NC HUB.

The Bidder shall make good faith efforts to encourage participation of M/WBEs prior to submission of bids in order to be considered as a responsive bidder. Bidders are cautioned that even though their submittal indicates they will meet the M/WBE goal, they should document their good faith efforts and be prepared to submit this information, if requested.

The M/WBE's listed by the Contractor on the Identification of Minority/Women Business Participation which are determined by the County to be certified shall perform the work and supply the materials for which they are listed unless the Contractors receive prior authorization from the County to perform the work with other forces or to obtain materials from other sources. If a contractor is proposing to perform all elements of the work with his own forces, he must be prepared to document evidence satisfactory to the owner of similar government contracts where he has self-performed.

The Contractor shall enter into and supply copies of fully executed subcontracts with each M/WBE or supply signed Letter(s) of Intent to the Project Manager after award of contract and prior to Notice to Proceed. Any amendments to subcontracts shall be submitted to the Project Manager prior to execution.

Instructions

The Bidder shall provide with the bid the following documentation:

- Identification of Minority/Women Business Participation
(if participation is zero, please mark zero—Blank forms will be considered nonresponsive)
- Affidavit A (if subcontracting)

OR

- Identification of Minority/Women Business Participation
(if participation is zero, please mark zero—Blank forms will be considered nonresponsive)
- Affidavit B (if self-performing; must attest that bidder does not customarily subcontract work on this type of project—includes supplies and materials)

Within 72 hours or 3 business days after notification of being the apparent low bidder who is subcontracting anything must provide the following information:

- Affidavit C (if aspirational goals are met or are exceeded)

OR

- Affidavit D (if aspirational goals are not met)

After award of contract and prior to issuance of notice to proceed:

- Letter(s) of Intent or Executed Contracts

**With each pay request, the prime contractors will submit the Proof of Payment Certification, listing payments made to M/WBE subcontractors.

***If a change is needed in M/WBE Participation, submit a Request to Change M/WBE Participation Form. Good Faith Efforts to substitute with another M/WBE contractor must be demonstrated.

Minimum Compliance Requirements:

All written statements, affidavits, or intentions made by the Bidder shall become a part of the agreement between the Contractor and the County for performance of contracts. Failure to comply with any of these statements, affidavits or intentions or with the minority business guidelines shall constitute a breach of the contract. A finding by the County that any information submitted (either prior to award of the contract or during the performance of the contract) is inaccurate, false, or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the County whether to terminate the contract for breach or not. In determining whether a contractor has

made Good Faith Efforts, the County will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts.

NEW HANOVER COUNTY Identification of Minority/Women Business Participation

I, _____,
(Name of Bidder)

do hereby certify that on this project, we will use the following minority/women business enterprises as construction subcontractors, vendors, suppliers or providers of professional services.

| Firm Name, Address and Phone # | Work type | *M/WBE Category |
|--------------------------------|-----------|-----------------|
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*M/WBE categories: Black, African American (B), Hispanic (H), Asian American (A) American Indian (I), Female (F) Socially and Economically Disadvantaged (S) Disabled (D)

If you will not be utilizing M/WBE contractors, please certify by entering zero “0”

The total value of MBE business contracting will be (\$)_____.

The total value of WBE business contracting will be (\$)_____.

NEW HANOVER COUNTY AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- 1 – (10 pts) Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- 2 --(10 pts) Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- 3 – (15 pts) Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- 4 – (10 pts) Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- 5 – (10 pts) Attended prebid meetings scheduled by the public owner.
- 6 – (20 pts) Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- 7 – (15 pts) Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- 8 – (25 pts) Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- 9 – (20 pts) Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- 10 - (20 pts) Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority/Women Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

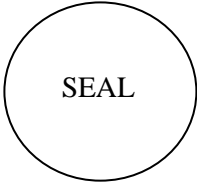
The undersigned hereby certifies that he or she has read the terms of the minority/women business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____

State of _____, County of _____



Subscribed and sworn to before me this _____ day of _____ 20____
Notary Public _____
My commission expires _____

NEW HANOVER COUNTY --AFFIDAVIT B-- Intent to Perform
Contract with Own Workforce.

County of _____

Affidavit of _____

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____

_____ contract.

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

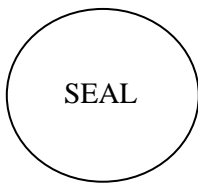
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20__

Notary Public _____

My commission expires _____

NEW HANOVER COUNTY - AFFIDAVIT C - Portion of the Work to be Performed by M/WBE Firms

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by M/WBE businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit. This affidavit shall be provided by the apparent lowest responsible, responsive bidder within 72 hours after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____ (Project Name)

Project ID# _____ Amount of Bid: \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with MBE firms and a minimum of _____% of the total dollar amount of the contract with WBE firms. Minority/women businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

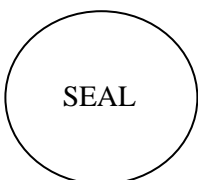
| Name and Phone Number | *M/WBE Category | Work description | Dollar Value |
|-----------------------|-----------------|------------------|--------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A) American Indi I), Female (F) Socially and Economically Disadvantaged (S) Disabled (D)

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with M/WBE Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

NEW HANOVER COUNTY AFFIDAVIT D – Good Faith Efforts

County of _____
(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by minority/women business is not achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the
(Name of Bidder)

_____ (Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with MBE firms and a minimum of _____% of the total dollar amount of the contract with WBE firms. Minority/women businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.
(Attach additional sheets if needed)

| Name and Phone Number | *M/WBE Category | Work description | Dollar Value |
|-----------------------|-----------------|------------------|--------------|
| | | | |
| | | | |
| | | | |
| | | | |

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A) American Indian (I), Female (F) Socially and Economically Disadvantaged (S) Disabled (D)

Examples of documentation required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster.

G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

H. Letter detailing reasons for rejection of minority business due to lack of qualification.

I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

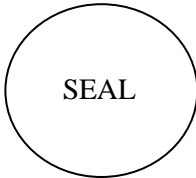
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with M/WBE Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____
_____ 20_____

Notary Public _____

My commission expires _____

LETTER OF INTENT M/WBE Subcontractor Performance

Please submit this form or executed subcontracts with M/WBE firms after award of contract and prior to issuance of notice to proceed.

PROJECT: _____
(Project Name)

TO: _____
(Name of Prime Bidder/Architect)

The undersigned intends to perform work in connection with the above project as a:

____ Minority Business Enterprise ____ Women Business Enterprise

The M/WBE status of the undersigned is certified the NC Office of Historically Underutilized Businesses (required). ____ Yes ____ No

The undersigned is prepared to perform the following described work or provide materials or services in connection with the above project at the following dollar amount:

| Work/Materials/Service Provided | Dollar Amount of Contract | Projected Start Date | Projected End Date |
|---------------------------------|---------------------------|----------------------|--------------------|
| | | | |
| | | | |

(Date)

(Address)

(Name & Phone No. of M/WBE Firm)

(Name & Title of Authorized Representative of M/WBE)

(Signature of Authorized Representative of M/WBE)

REQUEST TO CHANGE M/WBE PARTICIPATION

(Submit changes only if notified as apparent lowest bidder, continuing through project completion)

Project: _____

Bidder or Prime Contractor: _____

Name & Title of Authorized Representative: _____

Address: _____ Phone #: _____

_____ Email Address: _____

Total Contract Amount (including approved change orders or amendments): \$_____

Name of subcontractor: _____

Good or service provided: _____

Proposed Action:

Replace subcontractor

Perform work with own forces

For the above actions, you must provide one of the following reasons (Please check applicable reason):

The listed MBE/WBE, after having had a reasonable opportunity to do so, fails or refuses to execute a written contract.

The listed MBE/WBE is bankrupt or insolvent.

The listed MBE/WBE fails or refuses to perform his/her subcontract or furnish the listed materials.

The work performed by the listed subcontractor is unsatisfactory according to industry standards and is not in accordance with the plans and specifications; or the subcontractor is substantially delaying or disrupting the progress of the work.

If replacing subcontractor:

Name of replacement subcontractor: _____

The M/WBE status of the contractor is certified by the NC Office of Historically Underutilized Businesses (required). Yes No

Dollar amount of original contract \$ _____

Dollar amount of amended contract \$ _____

Other Proposed Action:

Increase total dollar amount of work Add additional subcontractor
 Decrease total dollar amount of work Other

Please describe reason for requested action: _____

If adding additional subcontractor:*

The M/WBE status of the contractor is certified by the NC Office of Historically Underutilized Businesses (required). Yes No

**Please attach Letter of Intent or executed contract document*

Dollar amount of original contract \$ _____

Dollar amount of amended contract \$ _____

| |
|---|
| Interoffice Use Only: |
| Approval <input type="checkbox"/> Y <input type="checkbox"/> N |
| Date _____ |
| Signature _____ |

| |
|----------------------------------|
| Pay Application No. _____ |
| Purchase Order No. _____ |

Proof of Payment Certification M/WBE Contractors, Suppliers, Service Providers

Project Name: _____

Prime Contractor: _____

Current Contract Amount (including change orders): \$_____

Requested Payment Amount for this Period: \$_____

Is this the final payment? ___Yes ___No

| Firm Name | M/WBE Category* | Total Amount Paid from this Pay Request | Total Contract Amount (including changes) | Total Amount Remaining |
|-----------|-----------------|---|---|------------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A) American Indian (I), Female (F) Socially and Economically Disadvantaged (S) Disabled (D)

Date: _____

Certified By: _____
Name

Title

Signature

STATE OF NORTH CAROLINA

COUNTY OF _____

AFFIDAVIT of COMPLIANCE
with N.C. E-Verify Statutes

I, _____ (hereinafter the "Affiant"), duly authorized by and on behalf of _____ (hereinafter the "Employer") after being first duly sworn deposes and says as follows:

1. I am the _____ (President, Manager, CEO, etc.) of the Employer and possess the full authority to speak for and on behalf of the Employer identified above.
2. Employer understands that "E-Verify" means the federal E-Verify program operated by the United States Dept. of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law.
3. _____ Employer employs 25 or more employees in the State of North Carolina, and is in compliance with the provisions of N.C. Gen. Stat. §64-26. Employer has verified the work authorization of its employees through E-Verify and shall retain the records of verification for a period of at least one year.

_____ Employer employs fewer than 25 Employees and is therefore not subject to the provisions of N.C. Gen. Stat. §64-26.
4. All subcontractors engaged by or to be engaged by Employer have or will have likewise complied with the provisions of N.C. Gen. Stat. §64-26.
5. Employer shall keep New Hanover County informed of any change in its status pursuant to Article 2 of Chapter 64 of the North Carolina General Statutes.

Further this affiant sayeth not.

This the _____ day of _____, 20____.

Affiant

STATE OF NORTH CAROLINA
COUNTY OF _____

Sworn to and subscribed before me, this the _____ day of _____, 20____.

Notary Public

[SEAL]

My commission expires: _____

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RFP Number (if applicable): _____

Name of Contractor: _____

**IRAN DIVESTMENT ACT CERTIFICATION
REQUIRED BY N.C.G.S. 147-86.55 et. seq.**

As of the date listed below, the Contractor listed above or any of its subcontractors are not listed on the Final Divestment List created by the State Treasurer pursuant to N.C.G.S. 147-86.58.

The undersigned hereby certifies that he or she is authorized by the Contractor listed above to make the foregoing statement.

Signature _____ Date _____

Printed Name _____ Title _____

Notes to persons signing this form:

N.C.G.S. 147-86.59 requires this certification for bids or contracts with the State of North Carolina, a North Carolina local government, or any other political subdivision of the State of North Carolina. The certification is required at the following times:

- When a bid is submitted
- When a contract is entered into (if the certification was not already made when the vendor made its bid)
- When a contract is renewed or assigned

N.C.G.S. 147-86.60 requires that contractors with the State, a North Carolina local government, or any other political subdivision of the State of North Carolina must not utilize any subcontractor found on the State Treasurer’s Final Divestment List.

The State Treasurer’s Final Divestment List can be found on the State Treasurer’s website at the address www.nctreasurer.com/iran and will be updated every 180 days.

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FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____
_____ as principal,
and _____, as surety, who is duly licensed
to act as surety in North Carolina, are held and firmly bound unto New Hanover County through
_____ as obligee, in the penal sum of
_____ DOLLARS, lawful money of the United States of America, for
the payment of which, well and truly to be made, we bind ourselves, our heirs, executors,
administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this ____ day of ____ 20__

WHEREAS, the said principal is herewith submitting proposal for and the principal
desires to file this bid bond in lieu of making
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if
the principal shall be awarded the contract for which the bid is submitted and shall execute the
contract and give bond for the faithful performance thereof within ten days after the award of
same to the principal, then this obligation shall be null and void; but if the principal fails to so
execute such contract and give performance bond as required by G.S. 143-129, the surety
shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph
hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

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FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal: _____
(Contractor)

Name of Surety: _____

Name of Contracting Body: NEW HANOVER COUNTY _____

Amount of Bond: _____

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

Name)

Contractor: (Trade or Corporate

By:

(Proprietorship or Partnership)

Attest: (Corporation)

Title

(Owner, Partner, or Corp. Pres. or Vice

Pres. only)

By: _____

Title: _____

(Corp. Sec. or Asst. Sec., only)

(Corporate Seal)

(Surety Company)

Witness:

By:

Title:

(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

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FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal: _____
(Contractor)

Name of Surety: _____

Name of Contracting Body: NEW HANOVER COUNTY _____

Amount of Bond: _____

Project: _____

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

Name)

(Proprietorship or Partnership)

Attest: (Corporation)

Contractor: (Trade or Corporate

By:

Title:

(Owner, Partner, or Corp. Pres. or
Vice Pres. only)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

Company) (Surety

Witness:

By:

Title:

(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

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AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

New Hanover County STAR Center

THE OWNER:

(Name, legal status and address)

New Hanover County
200 Division Drive
Wilmington NC, 28401

(Name, legal status and address)

LS3P, Inc
101 N 3rd Street, Suite 500
Wilmington, NC 28401

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- 13 MISCELLANEOUS PROVISIONS**
- 14 TERMINATION OR SUSPENSION OF THE CONTRACT**

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.

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

15 CLAIMS AND DISPUTES

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

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consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™-2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements,

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

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

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

§ 3.11 Documents and Samples at the Site

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

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

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

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

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

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

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

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the

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Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

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

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

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

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

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations

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and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

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

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor,

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

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

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

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

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

§ 6.2 Mutual Responsibility

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

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work,

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promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

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

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

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

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

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

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

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

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

affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

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unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

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

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

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

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

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

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

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§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

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

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

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

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

§ 9.6 Progress Payments

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

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

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

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

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

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

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

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

§ 9.7 Failure of Payment

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

§ 9.8 Substantial Completion

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

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

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

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§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

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

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

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

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

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

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

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

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

§ 11.2 Owner's Insurance

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

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

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

§ 11.3 Waivers of Subrogation

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

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

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

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

§ 11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to

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

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

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

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

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

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

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

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

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

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages

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

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

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

§ 15.2 Initial Decision

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

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

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

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

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

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

§ 15.4.4 Consolidation or Joinder

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

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

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

STANDARD SUPPLEMENTARY CONDITIONS

1. GENERAL CONDITIONS

The *General Conditions of the Contract for Construction*, AIA Document A201, 2007 Edition, Articles 1 through 15 inclusive, is a part of this Contract and is incorporated as fully as if herein set forth. For brevity, AIA Document A201 is also referred to in the Contract Documents collectively as the "General Conditions."

2. STANDARD SUPPLEMENTARY CONDITIONS

- 2.1 The following supplements modify, delete and/or add to the AIA Document A201, 2007 Edition. Where any portion of the General Conditions is modified or any paragraph, Section or clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of the General Conditions shall remain in effect.
- 2.2 Unless otherwise stated, the terms used in these Standard Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

3. MODIFICATIONS TO A201-2007

3.1 *Insert the following at the end of Section 1.1.1:*

Any reference in this document to the Agreement between the Owner and Contractor, AIA Document A101, or some abbreviated reference thereof, shall mean the AIA A101, 2007 Edition. Any reference in this document to the General Conditions of the Contract for Construction, AIA Document A201, or some abbreviated reference thereof, shall mean the AIA A201, 2007 Edition as modified by the Standard Supplementary Conditions.

- 3.2 Delete the language of Section 1.1.8 and substitute the word "Reserved."

- 3.3 Add the following Section 1.1.9:

1.1.9 NOTICE TO PROCEED

Notice to Proceed is a document issued by the Owner to the Contractor, with a copy to the Architect, directing the Contractor to begin prosecution of the Work in accordance with the requirements of the Contract Documents. The Notice to Proceed shall fix the date on which the Contract Time will commence.

- 3.4 Insert the following at the end of Section 1.2.1:

In the event of patent ambiguities within or between parts of the Contract Documents, the contractor shall 1) provide the better quality or greater quantity of Work, or 2) comply with the more stringent requirement, either or both in accordance with the Architect's interpretation.

- 3.5 Delete Section 1.5.1 and substitute the following:

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

- 3.6 Delete Section 2.1.1 and substitute the following:

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization, except as provided in Section 7.1.2. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's Representative. [Reference § 8.2 of the Agreement.]

- 3.7 Delete Section 2.1.2 and substitute the following:

2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to post Notice of Project Commencement pursuant to the North Carolina Code of Laws, as amended.

- 3.8 Delete Section 2.2.3 and substitute the following:

STANDARD SUPPLEMENTARY CONDITIONS

2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. Subject to the Contractor's obligations, including those in Section 3.2, the Contractor shall be entitled to rely on the accuracy of information furnished by the Owner pursuant to this Section but shall exercise proper precautions relating to the safe performance of the Work.

3.9 Replace the period at the end of the last sentence of Section 2.2.4 with a semicolon and insert the following after the inserted semicolon:

"however, the Owner does not warrant the accuracy of any such information requested by the Contractor that is not otherwise required of the Owner by the Contract Documents. Neither the Owner nor the Architect shall be required to conduct investigations or to furnish the Contractor with any information concerning subsurface characteristics or other conditions of the area where the Work is to be performed beyond that which is provide in the Contract Documents."

3.10 Delete Section 2.2.5 and substitute the following:

2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor with ten copies of the Contract Documents. The Contractor may make reproductions of the Contract Documents pursuant to Section 1.5.2. All copies of the drawings and specifications, except the Contractor's record set, shall be returned or suitably accounted for to the Owner, on request, upon completion of the Work.

3.11 Add the following Sections 2.2.6 and 2.2.7:

2.2.6 The Owner assumes no responsibility for any conclusions or interpretation made by the Contractor based on information made available by the Owner.

2.2.7 The Owner shall obtain, at its own cost, general building and specialty inspection services as required by the Contract Documents. The Contractor shall be responsible for payment of any charges imposed for reinspections.

3.12 Delete Section 2.4 and substitute the following:

2.4 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect, including but not limited to providing necessary resources, with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Directive shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

3.13 Insert the following at the end of Section 3.2.1:

The Contractor acknowledges that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Owner.

3.14 In the third sentence of Section 3.2.4, insert the word "latent" before the word "errors."

3.15 In the last sentence of Section 3.3.1, insert the words "by the Owner in writing" after the word "instructed."

3.16 Delete the third sentence of Section 3.5 and substitute the following sentences:

STANDARD SUPPLEMENTARY CONDITIONS

Work, materials, or equipment not conforming to these requirements shall be considered defective. Unless caused by the Contractor or a subcontractor at any tier, the Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage.

3.17 Insert the following at the end of Section 3.6:

The Contractor shall comply with the requirements of _____ the North Carolina Code of Laws, as amended, regarding withholding tax for nonresidents, employees, contractors and subcontractors.

3.18 NOT USED

3.19 Delete the last sentence of Section 3.7.5 and substitute the following:

Adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 7.3.3.

3.20 Delete the last sentence of Section 3.8.2.3 and substitute the following:

The amount of the Change Order shall reflect the difference between actual costs, as documented by invoices, and the allowances under Section 3.8.2.1.

3.21 In Section 3.9.1, insert a comma after the word "superintendent" in the first sentence and insert the following after the inserted comma:

acceptable to the Owner,

3.22 Delete Section 3.9.2 and substitute the following:

3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner the name and qualifications of a proposed superintendent. The Owner may reply within 14 days to the Contractor in writing stating (1) whether the Owner has reasonable objection to the proposed superintendent or (2) that the Owner requires additional time to review. Failure of the Owner to reply within the 14-day period shall constitute notice of no reasonable objection.

3.23 After the first sentence in Section 3.9.3, insert the following sentence:

The Contractor shall notify the Owner, in writing, of any proposed change in the superintendent, including the reason therefore, prior to making such change.

3.24 Delete Section 3.10.3 and substitute the following:

3.10.3 Additional requirements, if any, for the constructions schedule are as follows:
(Check box if applicable to this Contract))

The construction schedule shall be in a detailed precedence-style critical path management (CPM) or primavera-type format satisfactory to the Owner and the Architect that shall also (1) provide a graphic representation of all activities and events that will occur during performance of the work; (2) identify each phase of construction and occupancy; and (3) set forth dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as "Milestone Dates"). Upon review and acceptance by the Owner and the Architect of the Milestone Dates, the construction schedule shall be deemed part of the Contract Documents and attached to the Agreement as Exhibit "A." If not accepted, the construction schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner and the Architect and resubmitted for acceptance. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays. Whenever the approved construction schedule no longer reflects actual conditions and progress of the work or the Contract Time is modified in accordance with the terms of the Contract Documents, the Contractor shall update the accepted construction schedule to reflect such conditions. In the event any progress report indicates any delays, the Contractor shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any progress report constitute an adjustment in the Contract Time, any Milestone Date, or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to

STANDARD SUPPLEMENTARY CONDITIONS

Change Order.

3.25 Add the following Section 3.10.4:

3.10.4 Owner's review and acceptance of Contractor's schedule is not conducted for the purpose of either determining its accuracy and completeness or approving the construction means, methods, techniques, sequences or procedures. The Owner's approval shall not relieve the Contractor of any obligations. Unless expressly addressed in a Modification, the Owner's approval of a schedule shall not change the Contract Time.

3.26 Add the following Section 3.12.5.1:

3.12.5.1 The fire sprinkler shop drawings shall be prepared by a licensed fire sprinkler contractor and shall accurately reflect actual conditions affecting the required layout of the fire sprinkler system. The fire sprinkler contractor shall certify the accuracy of his shop drawings prior to submitting them for review and approval. The fire sprinkler shop drawings shall be reviewed and approved by the Architect's engineer of record who, upon approving the sprinkler shop drawings will submit them to the State Fire Marshal or other authorities having jurisdiction for review and approval. The Architect's engineer of record will submit a copy of the State Fire Marshal's approval letter to the Contractor and Consultant. Unless authorized in writing by Consultant, neither the Contractor nor subcontractor at any tier shall submit the fire sprinkler shop drawings directly to the State Fire Marshal or other authorities having jurisdiction for approval.

3.27 In the fourth sentence of Section 3.12.10, after the comma following the words "licensed design professional," insert the following:

who shall comply with reasonable requirements of the Owner regarding qualifications and insurance and

3.28 In Section 3.13, insert the section number "3.13.1" before the before the opening words "The Contractors shall."

3.29 Add the following Sections 3.13.2 and 3.13.3:

3.13.2 Protection of construction materials and equipment stored at the Project site from weather, theft, vandalism, damage, and all other adversity is solely the responsibility of the Contractor. The Contractor shall perform the work in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials, and equipment likely to cause hazardous conditions.

3.13.3 The Contractor and any entity for which the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner.

3.30 In the first sentence of Section 3.18.1, after the parenthetical "other than the Work itself" and before the word "but", insert the following:

including loss of use resulting therefrom,

3.31 Delete Section 4.1.1 and substitute the following:

4.1.1 The Architect is that person or entity identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

3.32 Insert the following at the end of Section 4.2.1:

Any reference in the Contract Documents to the Architect taking action or rendering a decision with a "reasonable time" is understood to mean no more than fourteen days, unless otherwise specified in the Contract Documents or otherwise agreed to by the parties.

3.33 Delete the first sentence of Section 4.2.2 and substitute the following:

The Architect will visit the site as necessary to fulfill its obligation to the Owner for inspection services, if any, and, at a minimum, to assure conformance with the Architect's design as shown in the Contract Documents and to observe the progress and quality of the various components of the Contractor's Work, and to determine if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents.

3.34 Delete the first sentence of Section 4.2.3 and substitute the following:

On the basis of the site visits, the Architect will keep the Owner informed about the progress and quality of the

STANDARD SUPPLEMENTARY CONDITIONS

portion of the Work completed, and report to the Owner (1) deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work.

- 3.35** In Section 4.2.5, after the words “evaluations of the” and before the word “Contractor’s,” insert the following:
Work completed and correlated with the
- 3.36** Delete the first sentence of Section 4.2.11 and substitute the following:
4.2.11 The Architect will, in the first instance, interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. Upon receipt of such request, the Architect will promptly provide the non-requesting party with a copy of the request.
- 3.37** Insert the following at the end of Section 4.2.12:
If either party disputes the Architects interpretation or decision, that party may proceed as provided in Article 15. The Architect’s interpretations and decisions may be, but need not be, accorded any deference in any review conducted pursuant to law or the Contract Documents.
- 3.38** Delete Section 4.2.14 and substitute the following:
The Architect will review and respond to requests for information about the Contract Documents so as to avoid delay to the construction of the Project. The Architect’s response to such requests will be made in writing with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information. Any response to a request for information must be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. Unless issued pursuant to a Modification, supplemental Drawings or Specifications will not involve an adjustment to the Contract Sum or Contract Time.
- 3.39** Delete Section 5.2.1 and substitute the following:
5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, within fourteen days after posting of the Notice of Intent to Award the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (excluding Listed Subcontractors but including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Owner may reply within 14 days to the Contractor in writing stating (1) whether the Owner has reasonable objection to any such proposed person or entity. Failure of the Owner to reply within the 14 day period shall constitute notice of no reasonable objection.
- 3.40** Delete Section 5.2.2 and substitute the following:
5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection. The Owner shall not direct the Contractor to contract with any specific individual or entity for supplies or services unless such supplies and services are necessary for completion of the Work and the specified individual or entity is the only source of such supply or services.
- 3.41** In the first sentence of Section 5.2.3, delete the words “...or Architect...” in the two places they appear.
- 3.42** Delete the words “...or Architect...” in the in the first sentence of Section 5.2.4 and insert the following sentence at the end of Section 5.2.4:
The Contractor’s request for substitution must be made to the Owner in writing accompanied by supporting information.
- 3.43** Add the following Section 5.2.5:
5.2.5 A Subcontractor identified in the Contractor’s Bid in response the specialty subcontractor listing requirements of Section 7 of the Bid Form (SE-330) may only be substituted in accordance with and as permitted by the provisions _____ of the North Carolina Code of Laws, as amended. A proposed substitute for a Listed Subcontractor shall be subject to the Owner’s approval as set forth in Section 5.2.3.
- 3.44** Add the following Section 5.2.6:
5.2.6 The Iran Divestment Act List is a list published by the State Fiscal Accountability Authority pursuant to Section 11-57-310 that identifies persons engaged in investment activities in Iran. Currently, the list is available

STANDARD SUPPLEMENTARY CONDITIONS

at the following URL: <http://procurement.sc.gov/PS/PS-iran-divestment.phtm>(.) Consistent with Section 11-57-330(B), the Contractor shall not contract with any person to perform a part of the Work, if, at the time you enter into the subcontract, that person is on the then-current version of the Iran Divestment Act List.

- 3.45** In Section 5.3, delete everything following the heading “SUBCONTRACTUAL RELATIONS” and insert the following Sections 5.3.1, 5.3.2, 5.3.3, and 5.3.4:

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

5.3.2 Without limitation on the generality of Section 5.3.1, each Subcontract agreement and each Sub-subcontract agreement shall include, and shall be deemed to include, the following Sections of these General Conditions: 3.2, 3.5, 3.18, 5.3, 5.4, 6.2.2, 7.3.3, 7.5, 7.6, 13.1, 13.12, 14.3, 14.4, and 15.1.6.

5.3.3 Each Subcontract Agreement and each Sub-subcontract agreement shall exclude, and shall be deemed to exclude, Sections 13.2.1 and 13.6 and all of Article 15, except Section 15.1.6, of these General Conditions. In the place of these excluded sections of the General Conditions, each Subcontract Agreement and each Sub-subcontract may include Sections 13.2.1 and 13.6 and all of Article 15, except Section 15.1.6, of AIA Document A201-2007, Conditions of the Contract, as originally issued by the American Institute of Architects.

5.3.4 The Contractor shall assure the Owner that all agreements between the Contractor and its Subcontractor incorporate the provisions of Subparagraph 5.3.1 as necessary to preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the work to be performed by Subcontractors so that the subcontracting thereof will not prejudice such rights. The Contractor’s assurance shall be in the form of an affidavit or in such other form as the Owner may approve. Upon request, the Contractor shall provide the Owner or Architect with copies of any or all subcontracts or purchase orders.

- 3.46** Delete the last sentence of Section 5.4.1.

- 3.47** Add the following Sections 5.4.4, 5.4.5 and 5.4.6:

5.4.4 Each subcontract shall specifically provide that the Owner shall only be responsible to the subcontractor for those obligations of the Contractor that accrue subsequent to the Owner’s exercise of any rights under this conditional assignment.

5.4.5 Each subcontract shall specifically provide that the Subcontractor agrees to perform portions of the Work assigned to the Owner in accordance with the Contract Documents.

5.4.6 Nothing in this Section 5.4 shall act to reduce or discharge the Contractor’s payment bond surety’s obligations to claimants for claims arising prior to the Owner’s exercise of any rights under this conditional assignment.

- 3.48** Delete the language of Section 6.1.4 and substitute the word “Reserved.”

- 3.49** Insert the following at the end of Section 7.1.2:

If the amount of a Modification exceeds the limits of the Owner’s Construction Change Order Certification (reference Section 9.1.7.2 of the Agreement), then the Owner’s agreement is not effective, and Work may not proceed, until approved in writing by the Consultant.

- 3.50** Delete Section 7.2.1 and substitute the following:

STANDARD SUPPLEMENTARY CONDITIONS

7.2.1 A Change Order is a written instrument prepared by the Architect (using State Form SE-380 “Construction Change Order”) and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

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

3.51 Add the following Sections 7.2.2, 7.2.3, 7.2.4, and 7.2.5:

7.2.2 If a Change Order provides for an adjustment to the Contract Sum, the adjustment must be calculated in accordance with Section 7.3.3.

7.2.3 At the Owner’s request, the Contractor shall prepare a proposal to perform the work of a proposed Change Order setting forth the amount of the proposed adjustment, if any, in the Contract Sum; and the extent of the proposed adjustment, if any, in the Contract Time. Any proposed adjustment in the Contract sum shall be prepared in accordance with Section 7.2.2. The Owner’s request shall include any revisions to the Drawings or Specifications necessary to define any changes in the Work. Within fifteen days of receiving the request, the Contractor shall submit the proposal to the Owner and Architect along with all documentation required by Section 7.6.

7.2.4 If the Contractor requests a Change Order, the request shall set forth the proposed change in the Work and shall be prepared in accordance with Section 7.2.3. If the Contractor requests a change to the Work that involves a revision to either the Drawings or Specifications, the Contractor shall reimburse the Owner for any expenditure associated with the Architects’ review of the proposed revisions, except to the extent the revisions are accepted by execution of a Change Order.

7.2.5 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, any adjustments to the Contract Sum or the Contract Time.

3.52 Delete 7.3.3 and substitute the following:

7.3.3 PRICE ADJUSTMENTS

7.3.3.1 If any Modification, including a Construction Change Directive, provides for an adjustment to the Contract Sum, the adjustment shall be based on whichever of the following methods is the most valid approximation of the actual cost to the contractor, with overhead and profit as allowed by Section 7.5:

- .1 Mutual acceptance of a lump sum;
- .2 Unit prices stated in the Contract Documents, except as provided in Section 7.3.4, or subsequently agreed upon;
- .3 Cost attributable to the events or situations under applicable clauses with adjustment of profits or fee, all as specified in the contract, or subsequently agreed upon by the parties, or by some other method as the parties may agree; or
- .4 As provided in Section 7.3.7.

7.3.3.2 Consistent with Section 7.6, costs must be properly itemized and supported by substantiating data sufficient to permit evaluation before commencement of the pertinent performance or as soon after that as practicable. All costs incurred by the Contractor must be justifiably compared with prevailing industry standards. Except as provided in Section 7.5, all adjustments to the Contract Price shall be limited to job specific costs and shall not include indirect costs, overhead, home office overhead, or profit.

3.53 Delete Section 7.3.7 and substitute the following:

7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall make an initial determination, consistent with Section 7.3.3, of the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in Section 7.5. In such case, and also under Section 7.3.3.1.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

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

3.54 Delete Section 7.3.8 and substitute the following:

7.3.8 Using the percentages stated in Section 7.5, any adjustment to the Contract Sum for deleted work shall include any overhead and profit attributable to the cost for the deleted Work.

3.55 Add the following Sections 7.5 and 7.6:

7.5 AGREED OVERHEAD AND PROFIT RATES

- 7.5.1** For any adjustment to the Contract Sum for which overhead and profit may be recovered, other than those made pursuant to Unit Prices stated in the Contract Documents, the Contractor agrees to charge and accept, as full payment for overhead and profit, the following percentages of costs attributable to the change in the Work. The percentages cited below shall be considered to include all indirect costs including, but not limited to: field and office managers, supervisors and assistants, incidental job burdens, small tools, and general overhead allocations. The allowable percentages for overhead and profit are as follows: .1 To the Contractor for work performed by the Contractor's own forces, 17% of the Contractor's actual costs.
- .2 To each Subcontractor for work performed by the Subcontractor's own forces, 17% of the subcontractor's actual costs.
 - .3 To the Contractor for work performed by a subcontractor, 10% of the subcontractor's actual costs (not including the subcontractor's overhead and profit).

7.6 PRICING DATA AND AUDIT

7.6.1 Cost or Pricing Data.

Upon request of the Owner or Architect, Contractor shall submit cost or pricing data prior to execution of a Modification which exceeds \$500,000. Contractor shall certify that, to the best of its knowledge and belief, the cost or pricing data submitted is accurate, complete, and current as of a mutually determined specified date prior to the date of pricing the Modification. Contractor's price, including profit, shall be adjusted to exclude any significant sums by which such price was increased because Contractor furnished cost or pricing data that was inaccurate, incomplete, or not current as of the date specified by the parties. Notwithstanding Subparagraph 9.10.4, such adjustments may be made after final payment to the Contractor.

7.6.2 Cost or pricing data means all facts that, as of the date specified by the parties, prudent buyers and sellers would reasonably expect to affect price negotiations significantly. Cost or pricing data are factual, not judgmental; and are verifiable. While they do not indicate the accuracy of the prospective contractor's judgment about estimated future costs or projections, they do include the data forming the basis for that judgment. Cost or pricing data are more than historical accounting data; they are all the facts that can be reasonably expected to contribute to the soundness of estimates of future costs and to the validity of determinations of costs already incurred.

7.6.3 Records Retention.

As used in Section 7.6, the term "records" means any books or records that relate to cost or pricing data that Contractor is required to submit pursuant to Section 7.6.1. Contractor shall maintain records for three years from the date of final payment, or longer if requested by the chief procurement officer. The Owner may audit Contractor's records at reasonable times and places.

3.56 Delete Section 8.2.2 and substitute the following:

8.2.2 The Contractor shall not knowingly commence operations on the site or elsewhere prior to the effective date of surety bonds and insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such surety bonds or insurance.

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3.57 Delete Section 8.3.1 and substitute the following:

8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the control of the Contractor and any subcontractor at any tier; or by delay authorized by the Owner pending dispute resolution; or by other causes that the Architect determines may justify delay, then to the extent such delay will prevent the Contractor from achieving Substantial Completion within the Contract Time and provided the delay (1) is not caused by the fault or negligence of the Contractor or a subcontractor at any tier and (2) is not due to unusual delay in the delivery of supplies, machinery, equipment, or services when such supplies, machinery, equipment, or services were obtainable from other sources in sufficient time for the Contractor to meet the required delivery, the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

3.58 Insert the following at the end of Section 9.1:

All changes to the Contract Sum shall be adjusted in accordance with Section 7.3.3.

3.59 Delete Section 9.2 and substitute the following:

9.2 SCHEDULE OF VALUES

9.2.1 The Contractor shall submit to the Architect, within ten days of full execution of the Agreement, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. As requested by the Architect, the Contractor and each Subcontractor shall prepare a trade payment breakdown for the Work for which each is responsible, such breakdown being submitted on a uniform standardized format approved by the Architect and Owner. The breakdown shall be divided in detail, using convenient units, sufficient to accurately determine the value of completed Work during the course of the Project. The Contractor shall update the schedule of values as required by either the Architect or Owner as necessary to reflect:

- .1 the description of Work (listing labor and material separately);
- .2 the total value;
- .3 the percent and value of the Work completed to date;
- .4 the percent and value of previous amounts billed; and
- .5 the current percent completed and amount billed.

9.2.2 Any schedule of values or trade breakdown that fails to include sufficient detail, is unbalanced, or exhibits "front-loading" of the value of the Work shall be rejected. If a schedule of values or trade breakdown is used as the basis for payment and later determined to be inaccurate, sufficient funds shall be withheld from future Applications for Payment to ensure an adequate reserve (exclusive of normal retainage) to complete the Work.

3.60 Delete Section 9.3.1 and substitute the following:

Monthly, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2., for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require (such as copies of requisitions from Subcontractors and material suppliers) and shall reflect retainage and any other adjustments provided in Section 5 of the Agreement. If required by the Owner or Architect, the Application for Payment shall be accompanied by a current construction schedule.

3.61 In Section 9.3.2, add the following words to the end of the second sentence:

provided such materials or equipment will be subsequently incorporated in the Work

Insert the following at the end of Section 9.3.2:

The Contractor shall 1) protect such materials from diversion, vandalism, theft, destruction, and damage, 2) mark such materials specifically for use on the Project, and 3) segregate such materials from other materials at the storage facility. The Architect and the Owner shall have the right to make inspections of the storage areas at any time.

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- 3.62** In Section 9.4.2, in the first sentence, after the words “Work has progressed to the point indicated,” insert the following:
in both the Application for Payment and, if required to be submitted by the Contractor, the accompanying current construction schedule
In the last sentence, delete the third item starting with “(3) reviewed copies” and ending with “Contractor’s right to payment,”
- 3.63** In Section 9.5.1, in the first sentence, delete the word “may” after the opening words “The Architect” and substitute the word “shall.”
In Section 9.5.1, insert the following sentence after the first sentence:
The Architect shall withhold a Certificate of Payment if the Application for Payment is not accompanied by the current construction schedule required by Section 3.10.1.
- 3.64** NOT USED
- 3.65** Delete Section 9.7 and substitute following:
9.7 FAILURE OF PAYMENT
If the Architect does not issue a Certificate for Payment to the Owner, through no fault of the Contractor, within seven days after receipt of the Contractor’s Application for Payment, or if the Owner does not pay the Contractor within seven days after the time established in the Contract Documents the amount certified by the Architect or awarded by a final dispute resolution order, then the Contractor may, upon seven additional days’ written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased, in accordance with the provisions of Section 7.3.3, by the amount of the Contractor’s reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.
- 3.66** Insert the following words at the end of the sentence in Section 9.8.1:
and when all required occupancy permits, if any, have been issued and copies have been delivered to the Owner.
- 3.67** In Section 9.8.2, insert the word “written” after the word “comprehensive” and before the word “list.”
- 3.68** Delete Section 9.8.3 and substitute the following:
9.8.3.1 Upon receipt of the Contractor’s list, the Architect, with the Owner and any other person the Architect or the Owner choose, will make an inspection on a date and at a time mutually agreeable to the Architect, Owner, and Contractor, to determine whether the Work or designated portion thereof is substantially complete. The Contractor shall furnish access for the inspection and testing as provided in this Contract. The inspection shall include a demonstration by the Contractor that all equipment, systems and operable components of the Work function properly and in accordance with the Contract Documents. If the Architect’s inspection discloses any item, whether or not included on the Contractor’s list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion. If more than one Substantial Completion inspection is required, the Contractor shall reimburse the Owner for all costs of reinspections or, at the Owner’s option, the costs may be deducted from payments due to the Contractor.
9.8.3.2 If the Architect and Owner concur in the Contractor’s assessment that the Work or a portion of the Work is safe to occupy, the Owner and Contractor may arrange for a Certificate of Occupancy Inspection by the code official. The Owner, Architect, and Contractor shall be present at the code official’s inspection. Upon verifying that the Work or a portion of the Work is substantially complete and safe to occupy, the code official will issue, as appropriate, a Full or Partial Certificate of Occupancy.
- 3.69** In the second sentence of Section 9.8.5, delete the words “and consent of surety, if any.”
- 3.70** In the first sentence of Section 9.9.1, delete the words “Section 11.3.1.5” and substitute the words “Section 11.3.1.3.”
- 3.71** Delete Section 9.10.1 and substitute the following:

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9.10.1 Unless the parties agree otherwise in the Certificate of Substantial Completion, the Contractor shall achieve Final Completion no later than thirty days after Substantial Completion. Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect, with the Owner and any other person the Architect or the Owner choose, will make an inspection on a date and at a time mutually agreeable to the Architect, Owner, and Contractor, and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. If more than one Final Completion inspection is required, the Contractor shall reimburse the Owner for all costs of reinspections or, at the Owner's option, the costs may be deducted from payments due to the Contractor. If the Contractor does not achieve final completion within thirty days after Substantial Completion or the timeframe agreed to by the parties in the Certificate of Substantial Completion, whichever is greater, the Contractor shall be responsible for any additional Architectural fees resulting from the delay.

- 3.72** Delete the first sentence of Section 9.10.2 and substitute the following:

Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner, (6) required Training Manuals, (7) equipment Operations and Maintenance Manuals, (8) any certificates of testing, inspection or approval required by the Contract Documents and not previously provided (9) all warranties and guarantees required under or pursuant to the Contract Documents, and (10) one copy of the Documents required by Section 3.11.

- 3.73** Delete the first sentence of Section 9.10.3 and substitute the following:

If, after Substantial Completion of the Work, final completion thereof is delayed 60 days through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted.

- 3.74** Delete Section 9.10.5 and substitute the following:

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

- 3.75** Add the following Section 9.10.6:

9.10.6 If the code official has not previously issued a Certificate of Occupancy for the entire Project, the Parties shall arrange for a representative of the code official to participate in the Final Completion Inspection. Representatives of the State Fire Marshal's Office and other authorities having jurisdiction may be present at the Final Completion Inspection or otherwise inspect the completed Work and advise the Owner whether the Work meets their respective requirements for the Project.

- 3.76** Delete Section 10.3.1 and substitute the following:

10.3.1 If the Contractor encounters a hazardous material or substance which was not discoverable as provided in Section 3.2.1 and not required by the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons or serious loss to real or personal property resulting from such material or substance encountered on the site by the Contractor, the Contractor shall, upon

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recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. Hazardous materials or substances are those hazardous, toxic, or radioactive materials or substances subject to regulations by applicable governmental authorities having jurisdiction, such as, but not limited to, the S.C. Department of Health and Environmental Control, the U.S. Environmental Protection Agency, and the U.S. Nuclear Regulatory Commission.

3.77 Insert the following at the end of Section 10.3.2:

In the absence of agreement, the Architect will make an interim determination regarding any delay or impact on the Contractor's additional costs. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15. Any adjustment in the Contract Sum shall be determined in accordance with Section 7.3.3.

3.78 Delete Section 10.3.3 and substitute the following:

10.3.3 The Work in the affected area shall be resumed immediately following the occurrence of any one of the following events: (a) the Owner causes remedial work to be performed that results in the absence of hazardous materials or substances; (b) the Owner and the Contractor, by written agreement, decide to resume performance of the Work; or (c) the Work may safely and lawfully proceed, as determined by an appropriate governmental authority or as evidenced by a written report to both the Owner and the Contractor, which is prepared by an environmental engineer reasonably satisfactory to both the Owner and the Contractor.

3.79 In Section 10.3.5, delete the word "The" at the beginning of the sentence and substitute the following:

In addition to its obligations under Section 3.18, the

3.80 Delete the language of Section 10.3.6 and substitute the word "Reserved."

3.81 Insert the following at the end of Section 10.4:

The Contractor shall immediately give the Architect notice of the emergency. This initial notice may be oral followed within five days by a written notice setting forth the nature and scope of the emergency. Within fourteen days of the start of the emergency, the Contractor shall give the Architect a written estimate of the cost and probable effect of delay on the progress of the Work.

3.82 Delete 11.1.2 and substitute the following:

11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified below or required by law, whichever coverage is greater. Coverages shall be written on an occurrence basis and shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

(1) COMMERCIAL GENERAL LIABILITY:

| | |
|--|-------------|
| (a) General Aggregate (per project) _____ | \$2,000,000 |
| (b) Products/Completed Operations _____ | \$2,000,000 |
| (c) Personal and Advertising Injury _____ | \$1,000,000 |
| (d) Each Occurrence _____ | \$1,000,000 |

(2) BUSINESS AUTO LIABILITY (including All Owned, Non-owned, and Hired Vehicles): Automobile Bodily Injury and Property Damage Liability Insurance shall be carried on all automobiles, trucks, and similar vehicles that will be used in any phase of the Work required under this Contract. The minimum limits of liability required for such insurance are as follows:

| | |
|--|-------------|
| (a) Combined Single Limit _____ | \$1,000,000 |
|--|-------------|

(3) WORKER'S COMPENSATION – Statutory – and Employers' Liability Insurance that complies with the laws of the State of North Carolina shall be carried on all employees engaged in any and all phases of the Work required under this Contract, with minimum limits as follows:

| | |
|--------------------------------------|--------------------|
| (4) WORKER'S COMPENSATION: | Statutory |
| (a) State Statutory | |
| (b) Employers Liability _____ | \$500,000 Per Acc. |

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- _____ \$500,000 Disease, Policy Limit
_____ \$500,000 Disease, Each Employee
- (5) Excess Umbrella Liability (occurrence Form) with minimum limits as follows:
(a) Each Occurrence: _____ \$2,000,000
(b) Aggregate _____ \$2,000,000
- (6) Owner's & Contractor's Protective Bodily Injury and Properly Damage Liability Insurance must be provided by the Contractor for the benefit of the Owner covering the entire operation involved in the Contract. The minimum limits of liability required for such insurance are as follows:
(a) Same Limits as General Liability Coverage.
(b) Extend policy to include interest of Architects.

3.83 Delete Section 11.1.3 and substitute the following:

11.1.3 Prior to commencement of the Work, and thereafter upon replacement of each required policy of insurance, Contractor shall provide to the Owner a written endorsement to the Contractor's general liability insurance policy that:

- (i) names the Owner as an additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations;
- (ii) provides that no material alteration, cancellation, non-renewal, or expiration of the coverage contained in such policy shall have effect unless all additional insureds have been given at least ten (10) days prior written notice of cancellation for non-payment of premiums and thirty (30) days prior written notice of cancellation for any other reason; and
- (iii) provides that the Contractor's liability insurance policy shall be primary, with any liability insurance of the Owner as secondary and noncontributory.

Prior to commencement of the Work, and thereafter upon renewal or replacement of each required policy of insurance, Contractor shall provide to the Owner a signed, original certificate of liability insurance (ACORD 25). Consistent with this Section 11.1, the certificate shall identify the types of insurance, state the limits of liability for each type of coverage, name the Owner a Consultants as Certificate Holder, provide that the general aggregate limit applies per project, and provide that coverage is written on an occurrence basis. Both the certificates and the endorsements must be received directly from either the Contractor's insurance agent or the insurance company. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, naming the Owner as an additional insured for claims made under the Contractor's completed operations, and otherwise meeting the above requirements, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

3.84 Delete Section 11.1.4 and substitute the following:

11.1.4 A failure by the Owner either (i) to demand a certificate of insurance or written endorsement required by Section 11.1, or (ii) to reject a certificate or endorsement on the grounds that it fails to comply with Section 11.1 shall not be considered a waiver of Contractor's obligations to obtain the required insurance.

3.85 In Section 11.3.1, delete the first sentence and substitute the following:

Unless otherwise provided in the Contract Documents, the Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis.

3.86 Delete the language of Section 11.3.1.2 and substitute the word "Reserved."

3.87 Delete the language of Section 11.3.1.3 and substitute the word "Reserved."

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3.88 Delete Section 11.3.2 and substitute the following:

11.3.2 BOILER AND MACHINERY INSURANCE

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

3.89 Delete Section 11.3.3 and substitute the following:

11.3.3 LOSS OF USE INSURANCE

The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. To the extent any losses are covered and paid for by such insurance, the Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

3.90 Delete Section 11.3.4 and substitute the following:

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

3.91 Delete the language of Section 11.3.5 and substitute the word "Reserved."

3.92 Delete Section 11.3.6 and substitute the following:

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

3.93 Delete the first sentence of Section 11.3.7 and substitute the following:

The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent the property insurance provided by the Contractor pursuant to this Section 11.3 covers and pays for the damage, except such rights as they have to proceeds of such insurance held by the Contractor as fiduciary.

3.94 Delete the first sentence of Section 11.3.8 and substitute the following:

A loss insured under the Contractor's property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10.

3.95 Delete Section 11.3.9 and substitute the following:

11.3.9 If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor.

3.96 Delete Section 11.3.10 and substitute the following:

11.3.10 The Contractor as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Contractor's exercise of this power; if such objection is made, the dispute shall be resolved in the manner provided in the contract between the parties in dispute as the method of binding dispute resolution. The Contractor as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with a final order or determination issued by the appropriate authority having jurisdiction over the dispute.

3.97 Delete Section 11.4.1 and substitute the following:

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11.4.1 Before commencing any services hereunder, the Contractor shall provide the Owner with Performance and Payment Bonds, each in an amount not less than the Contract Price set forth in Article 4 of the Agreement. The Surety shall have, at a minimum, a "Best Rating" of "A" as stated in the most current publication of "Best's Key Rating Guide, Property-Casualty". In addition, the Surety shall have a minimum "Best Financial Strength Category" of "Class V", and in no case less than five (5) times the contract amount. The Performance Bond shall be written on Form SE-355, "Performance Bond" and the Payment Bond shall be written on Form SE-357, "Labor and Material Payment Bond", and both shall be made payable to the Owner.

3.98 Delete Section 11.4.2 and substitute the following:

11.4.2 The Performance and Labor and Material Payment Bonds shall:

- .1** be issued by a surety company licensed to do business in North Carolina;
- .2** be accompanied by a current power of attorney and certified by the attorney-in-fact who executes the bond on the behalf of the surety company; and
- .3** remain in effect for a period not less than one (1) year following the date of Substantial Completion or the time required to resolve any items of incomplete Work and the payment of any disputed amounts, whichever time period is longer.

3.99 Add the following Sections 11.4.3 and 11.4.4:

11.4.3 Any bonds required by this Contract shall meet the requirements of the North Carolina Code of Laws and Regulations, as amended.

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

3.100 Delete Section 12.1.1 and substitute the following:

12.1.1 If a portion of the Work is covered contrary to the requirements specifically expressed in the Contract Documents, including inspections of work-in-progress required by all authorities having jurisdiction over the Project, it must, upon demand of the Architect or authority having jurisdiction, be uncovered for observation and be replaced at the Contractor's expense without change in the Contract Time.

3.101 In Section 12.2.2.1, delete the words "and to make a claim for breach of warranty" at the end of the third sentence.

3.102 In Section 12.2.2.3, add the following to the end of the sentence:
unless otherwise provided in the Contract Documents.

3.103 Insert the following at the end of Section 12.2.4:

If, prior to the date of Substantial Completion, the Contractor, a Subcontractor, or anyone for whom either is responsible, uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment, or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.

3.104 Delete Section 13.1 and substitute the following:

13.1 GOVERNING LAW

The Contract, any dispute, claim, or controversy relating to the Contract, and all the rights and obligations of the parties shall, in all respects, be interpreted, construed, enforced and governed by and under the laws of the State of North Carolina, except its choice of law rules.

3.105 Delete Section 13.2, including its Sub-Sections 13.2.1 and 13.2.2, and substitute the following:

13.2 SUCCESSORS AND ASSIGNS

The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole, or in part, without written consent of the other and then only in accordance with and as permitted by the North Carolina Code of Regulations, as amended. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

3.106 Delete Section 13.3 and substitute the following:

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13.3 WRITTEN NOTICE

Unless otherwise permitted herein, all notices contemplated by the Contract Documents shall be in writing and shall be deemed given:

- .1 upon actual delivery, if delivery is by hand;
- .2 upon receipt by the transmitting party of confirmation or reply, if delivery is by electronic mail, facsimile, telex or telegram;
- .3 upon receipt, if delivery is by the United States mail.

Notice to Contractor shall be to the address provided in Section 8.3.2 of the Agreement. Notice to Owner shall be to the address provided in Section 8.2.2 of the Agreement. Either party may designate a different address for notice by giving notice in accordance with this paragraph.

3.107 In Section 13.4.1, insert the following at the beginning of the sentence:

Unless expressly provided otherwise,

3.108 Add the following Section 13.4.3:

13.4.3 Notwithstanding Section 9.10.4, the rights and obligations which, by their nature, would continue beyond the termination, cancellation, rejection, or expiration of this contract shall survive such termination, cancellation, rejection, or expiration, including, but not limited to, the rights and obligations created by the following clauses:

- 1.5** Ownership and Use of Drawings, Specifications and Other Instruments of Service;
- 3.5** Warranty
- 3.17** Royalties, Patents and Copyrights
- 3.18** Indemnification
- 7.6** Cost or Pricing Data
- 11.1** Contractor's Liability Insurance
- 11.4** Performance and Payment Bond
- 15.1.6** Claims for Listed Damages
- 15.1.7** Waiver of Claims Against the Architect
- 15.6** Dispute Resolution
- 15.6.5** Service of Process

3.109 Delete Section 13.6 and substitute the following:

13.6 INTEREST

Payments due to the Contractor and unpaid under the Contract Documents shall bear interest only if and to the extent allowed by Title 29, Chapter 6, Article 1 of the North Carolina Code of Laws. Amounts due to the Owner shall bear interest at the rate of one percent a month or a pro rata fraction thereof on the unpaid balance as may be due.

3.110 Delete the language of Section 13.7 and substitute the word "Reserved."

3.111 Add the following Sections 13.8 through 13.16:

13.8 PROCUREMENT OF MATERIALS BY OWNER

The Contractor accepts assignment of all purchase orders and other agreements for procurement of materials and equipment by the Owner that are identified as part of the Contract Documents. The Contractor shall, upon delivery, be responsible for the storage, protection, proper installation, and preservation of such Owner purchased items, if any, as if the Contractor were the original purchaser. The Contract Sum includes, without limitation, all costs and expenses in connection with delivery, storage, insurance, installation, and testing of items covered in any assigned purchase orders or agreements. Unless the Contract Documents specifically provide otherwise, all Contractor warranty of workmanship and correction of the Work obligations under the Contract Documents shall apply to the Contractor's installation of and modifications to any Owner purchased items.

13.9 INTERPRETATION OF BUILDING CODES

As required by _____ the North Carolina Code of Laws, as amended, the code official shall determine the enforcement and interpretation of all building codes and referenced standards on

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state buildings. The Contractor shall refer any questions, comments, or directives from local officials to the Owner and the code official for resolution.

13.10 MINORITY BUSINESS ENTERPRISES

Contractor shall notify Owner of each Minority Business Enterprise (MBE) providing labor, materials, equipment, or supplies to the Project under a contract with the Contractor. Contractor's notification shall be via the first monthly status report submitted to the Owner after execution of the contract with the MBE. For each such MBE, the Contractor shall provide the MBE's name, address, and telephone number, the nature of the work to be performed or materials or equipment to be supplied by the MBE, whether the MBE is certified by the North Carolina Office of Small and Minority Business Assistance, and the value of the contract.

13.11 SEVERABILITY

If any provision or any part of a provision of the Contract Documents shall be finally determined to be superseded, invalid, illegal, or otherwise unenforceable pursuant to any applicable Legal Requirements, such determination shall not impair or otherwise affect the validity, legality, or enforceability of the remaining provision or parts of the provision of the Contract Documents, which shall remain in full force and effect as if the unenforceable provision or part were deleted.

13.12 ILLEGAL IMMIGRATION

Contractor certifies and agrees that it will comply with the applicable requirements of Title 8, Chapter 14 of the North Carolina Code of Laws and agrees to provide to the State upon request any documentation required to establish either: (a) that Title 8, Chapter 14 is inapplicable both to Contractor and its subcontractors or sub-subcontractors; or (b) that Contractor and its subcontractors or sub-subcontractors are in compliance with Title 8, Chapter 14. Pursuant to Section 8-14-60, "A person who knowingly makes or files any false, fictitious, or fraudulent document, statement, or report pursuant to this chapter is guilty of a felony and, upon conviction, must be fined within the discretion of the court or imprisoned for not more than five years, or both." Contractor agrees to include in any contracts with its subcontractors language requiring its subcontractors to (a) comply with the applicable requirements of Title 8, Chapter 14, and (b) include in their contracts with the sub-subcontractors language requiring the sub-subcontractors to comply with the applicable requirements of Title 8, Chapter 14.

13.13 SETOFF

The Owner shall have all of its common law, equitable, and statutory rights of set-off.

13.14 DRUG-FREE WORKPLACE

The Contractor certifies to the Owner that Contractor will provide a Drug-Free Workplace, as required by the North Carolina Code of Laws, as amended.

13.15 FALSE CLAIMS

"a person who by false pretense or representation obtains the signature of a person to a written instrument or obtains from another person any chattel, money, valuable security, or other property, real or personal, with intent to cheat and defraud a person of that property is guilty" of a crime.

13.16 NON-INDEMNIFICATION:

Any term or condition is void to the extent it requires the State to indemnify anyone. It is unlawful for a person charged with disbursements of state funds appropriated by the General Assembly to exceed the amounts and purposes stated in the appropriations. (§ 11-9-20) It is unlawful for an authorized public officer to enter into a contract for a purpose in which the sum is in excess of the amount appropriated for that purpose. It is unlawful for an authorized public officer to divert or appropriate the funds arising from any tax levied and collected for any one fiscal year to the payment of an indebtedness contracted or incurred for a previous year. (§ 11-1-40)

3.112 Delete Section 14.1.1 and substitute the following:

14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 45 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1** Issuance of an order of a court or other public authority having jurisdiction that requires substantially all Work to be stopped; or
- .2** An act of government, such as a declaration of national emergency that requires substantially all Work to be stopped.

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- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents and the Contractor has stopped work in accordance with Section 9.7

3.113 Insert the following at the end of Section 14.1.3:

Any adjustment to the Contract Sum pursuant to this Section shall be made in accordance with the requirements of Article 7.

3.114 In Section 14.1.4, replace the word “repeatedly” with the word “persistently.”

3.115 Delete Section 14.2.1 and substitute the following:

14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials, or otherwise fails to prosecute the Work, or any separable part of the Work, with the diligence, resources and skill that will ensure its completion within the time specified in the Contract Documents, including any authorized adjustments;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the Contract Documents and the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

3.116 In Section 14.2.2, delete the parenthetical statement “, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action,” immediately following the word “Owner” in the first line.

3.117 In Section 14.2.4, replace the words “Initial Decision Maker” with the word “Architect”

3.118 Add the following Section 14.2.5:

14.2.5 If, after termination for cause, it is determined that the Owner lacked justification to terminate under Section 14.2.1, or that the Contractor’s default was excusable, the rights and obligations of the parties shall be the same as if the termination had been issued for the convenience of the Owner under Section 14.4.

3.119 Delete the second sentence of Section 14.3.2 and substitute the following:

Any adjustment to the Contract Sum made pursuant to this section shall be made in accordance with the requirements of Article 7.3.3.

3.120 Delete Section 14.4.1 and substitute the following:

14.4.1 The Owner may, at any time, terminate the Contract, in whole or in part for the Owner’s convenience and without cause. The Owner shall give written notice of the termination to the Contractor specifying the part of the Contract terminated and when termination becomes effective.

3.121 Delete Section 14.4.2 and substitute the following:

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

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work;
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders; and
- .4 **complete the performance of the Work not terminated, if any.**

3.122 Delete Section 14.4.3 and substitute the following:

14.4.3 In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, costs incurred by reason of such termination, and any other adjustments otherwise allowed by the Contract. Any adjustment to the Contract Sum made pursuant to this Section 14.4 shall be made in accordance with the requirements of Article 7.3.3.

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3.123 Add the following Sections 14.4.4, 14.4.5, and 14.5:

3.124 Insert the following sentence after the second sentence of Section 15.1.1:

A voucher, invoice, payment application or other routine request for payment that is not in dispute when submitted is not a Claim under this definition.

3.125 Delete Section 15.1.2 and substitute the following:

15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Architect. Such notice shall include sufficient information to advise the Architect and other party of the circumstances giving rise to the claim, the specific contractual adjustment or relief requested and the basis of such request. Claims by either party arising prior to the date final payment is due must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later except as stated for adverse weather days in Section 15.1.5.2.

By failing to give written notice of a Claim within the time required by this Section, a party expressly waives its claim.

3.126 Delete Section 15.1.3 and substitute the following:

15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, including any administrative review allowed under Section 15.6, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will issue Certificates for Payment in accordance with the initial decisions and determinations of the Architect.

3.127 Insert the following at the end of Section 15.1.6.1:

Claims for an increase in the Contract Time shall be based on one additional calendar day for each full calendar day that the Contractor is prevented from working.

3.128 Insert the following Sub-Sections at the end of Section 15.1.6.2:

- .1** Claims for adverse weather shall be based on actual weather conditions at the job site or other place of performance of the Work, as documented in the Contractor's job site log.
- .2** For the purpose of this Contract, a total of five (5) days per calendar month (non-cumulative) shall be anticipated as "adverse weather" at the job site, and such time will not be considered justification for an extension of time. If, in any month, adverse weather develops a precipitation/water amount of .01" or greater beyond the five (5) days, the Contractor shall be allowed to claim additional days to compensate for the excess weather delays only to the extent of the impact on the approved construction schedule and days the contractor was already scheduled to work. The remedy for this condition is for an extension of time only and is exclusive of all other rights and remedies available under the Contract Documents or imposed or available by law.

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.3 The Contractor shall submit monthly with their pay application all claims for adverse weather conditions that occurred during the previous month. The Architect shall review each monthly submittal in accordance with Section 15.5 and inform the Contractor and the Owner promptly of its evaluation. Approved days shall be included in the next Change Order issued by the Architect. Adverse weather conditions not claimed within the time limits of this Subparagraph shall be considered to be waived by the Contractor. Claims will not be allowed for adverse weather days that occur after the scheduled (original or adjusted) date of Substantial Completion.

3.129 Delete Section 15.1.6 and substitute the following:

15.1.6 CLAIMS FOR LISTED DAMAGES

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor and Owner waive Claims against each other for listed damages arising out of or relating to this Contract.

15.1.6.1 For the Owner, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) costs suffered by a third party unable to commence work, (vi) attorney's fees, (vii) any interest, except to the extent allowed by Section 13.6 (Interest), (viii) lost revenue and profit for lost use of the property, (ix) costs resulting from lost productivity or efficiency.

15.1.6.2 For the Contractor, listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) attorney's fees, (vi) any interest, except to the extent allowed by Section 13.6 (Interest); (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. Without limitation, this mutual waiver is applicable to all damages due to either party's termination in accordance with Article 14.

15.1.6.3 Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

3.130 Add the following Section 15.1.7:

15.1.7 WAIVER OF CLAIMS AGAINST THE ARCHITECT

Notwithstanding any other provision of the Contract Documents, including Section 1.2.1, but subject to a duty of good faith and fair dealing, the Contractor waives all claims against the Architect and any other design professionals who provide design and/or project management services to the Owner, either directly or as independent contractors or subcontractors to the Architect, for listed damages arising out of or relating to this Contract. The listed damages are (i) lost revenue and profit, (ii) losses resulting from injury to business or reputation, (iii) additional or escalated overhead and administration expenses, (iv) additional financing costs, (v) attorney's fees, (vi) any interest; (vii) unamortized equipment costs; and, (viii) losses incurred by subcontractors for the types of damages the Contractor has waive as against the Owner. This mutual waiver is not applicable to amounts due or obligations under Section 3.18 (Indemnification).

3.131 Delete the language of Sections 15.2, 15.3, and 15.4, including all Sub-Sections, and substitute the word "Reserved" for the deleted language of each Section and Sub-Section.

3.132 Add the following Sections 15.5 and 15.6 with their sub-sections:

15.5 CLAIM AND DISPUTES - DUTY OF COOPERATION, NOTICE, AND ARCHITECTS INITIAL DECISION

15.5.1 Contractor and Owner are fully committed to working with each other throughout the Project to avoid or minimize claims. To further this goal, Contractor and Owner agree to communicate regularly with each other and the Architect at all times notifying one another as soon as reasonably possible of any issue that if not addressed may cause loss, delay, and/or disruption of the Work. If claims do arise, Contractor and Owner each commit to resolving such claims in an amicable, professional, and expeditious manner to avoid unnecessary losses, delays, and disruptions to the Work.

15.5.2 Claims shall first be referred to the Architect for initial decision. An initial decision shall be required as a condition precedent to resolution pursuant to Section 15.6 of any Claim arising

prior to the date of final payment, unless 30 days have passed after the Claim has been referred to the Architect with no decision having been rendered, or after all the Architect's requests for additional supporting data have been answered, whichever is later. The Architect will not address claims between the Contractor and persons or entities other than the Owner.

- 15.5.3** The Architect will review Claims and within ten days of the receipt of a Claim (1) request additional supporting data from the claimant or a response with supporting data from the other party or (2) render an initial decision in accordance with Section 15.5.5.
- 15.5.4** If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Architect when the response or supporting data will be furnished or (3) advise the Architect that all supporting data has already been provided. Upon receipt of the response or supporting data, the Architect will render an initial decision in accordance with Section 15.5.5.
- 15.5.5** The Architect will render an initial decision in writing; (1) stating the reasons therefor; and (2) notifying the parties of any change in the Contract Sum or Contract Time or both. The Architect will deliver the initial decision to the parties within two weeks of receipt of any response or supporting data requested pursuant to Section 16.4 or within such longer period as may be mutually agreeable to the parties. If the parties accept the initial decision, the Architect shall prepare a Change Order with appropriate supporting documentation for the review and approval of the parties. If either the Contractor, Owner, or both, disagree with the initial decision, the Contractor and Owner shall proceed with dispute resolution in accordance with the provisions of Section 15.6.
- 15.5.6** In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

15.6 DISPUTE RESOLUTION

- 15.6.1** If a claim is not resolved pursuant to Section 15.5 to the satisfaction of either party, both parties shall attempt to resolve the dispute at the field level through discussions between Contractor's Representative and Owner's Representative. If a dispute cannot be resolved through Contractor's Representative and Owner's Representative, then the Contractor's Senior Representative and the Owner's Senior Representative, upon the request of either party, shall meet as soon as conveniently possible, but in no case later than twenty-one days after such a request is made, to attempt to resolve such dispute. Prior to any meetings between the Senior Representatives, the parties will exchange relevant information that will assist the parties in resolving their dispute. The meetings required by this Section are a condition precedent to resolution pursuant to Section 15.6.2.
- 15.6.2** If after meeting in accordance with the provisions of Section 15.6.1, the Senior Representatives determine that the dispute cannot be resolved on terms satisfactory to both the Contractor and the Owner, then either party may submit the dispute by written request to North Carolina's Chief Procurement Officer for Construction (CPOC). **Except as otherwise provided in Article 15, all claims, claims, or controversies relating to the Contract shall be resolved exclusively by the appropriate Chief Procurement Officer in accordance with Title 11, Chapter 35, Article 17 of the North Carolina Code of Laws, or in the absence of jurisdiction, only in the Court of Common Pleas for, or in the absence of jurisdiction a federal court located in,** Contractor agrees that **any act by the State regarding the Contract is not a waiver of either the State's sovereign immunity or the State's immunity under the Eleventh Amendment of the United State's Constitution.**
- 15.6.3** If any party seeks resolution to a dispute pursuant to Section 15.6.2, the parties shall participate in non-binding mediation to resolve the claim. If the claim is governed by the North Carolina Code of Laws as amended and the amount in controversy is \$100,000.00 or less, the CPOC shall appoint a mediator, otherwise, the mediation shall be

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conducted by an impartial mediator selected by mutual agreement of the parties, or if the parties cannot so agree, a mediator designated by the American Arbitration Association (“AAA”) pursuant to its Construction Industry Mediation Rules. The mediation will be governed by and conducted pursuant to a mediation agreement negotiated by the parties or, if the parties cannot so agree, by procedures established by the mediator.

15.6.4 Without relieving any party from the other requirements of Sections 15.5 and 15.6, either party may initiate proceedings in the appropriate forum prior to initiating or completing the procedures required by Sections 15.5 and 15.6 if such action is necessary to preserve a claim by avoiding the application of any applicable statutory period of limitation or repose.

15.6.5 SERVICE OF PROCESS

Contractor consents that any papers, notices, or process necessary or proper for the initiation or continuation of any claims, claims, or controversies relating to the Contract; for any court action in connection therewith; or for the entry of judgment on any award made, may be served on Contractor by certified mail (return receipt requested) addressed to Contractor at the address provided for the Contractor’s Senior Representative or by personal service or by any other manner that is permitted by law, in or outside North Carolina. Notice by certified mail is deemed duly given upon deposit in the United States mail.

3.133 Add the following Article 16:

ARTICLE 16 PROJECT-SPECIFIC REQUIREMENTS AND INFORMATION

16.1. Inspection Requirements: (Indicate the inspection services required by the Contract)

- Special Inspections are required and are not part of the Contract Sum. (see section 014000)
- Building Inspections are required and are not part of the Contract Sum. (see section 014000)

The inspections required for this Work are:

(Indicate which services are required and the provider)

- Civil: _____
- Structural: _____
- Mechanical: _____
- Plumbing: _____
- Electrical: _____
- Gas: _____
- Other (list): Roofing

Remarks: All inspections provided by owner

16.1.1 Contractor shall schedule and request inspections in an orderly and efficient manner and shall notify the Owner whenever the Contractor schedules an inspection in accordance with the requirements of Section 16.1. Contractor shall be responsible for the cost of inspections scheduled and conducted without the Owner’s knowledge and for any increase in the cost of inspections resulting from the inefficient scheduling of inspections.

DOCUMENT 001116 - INVITATION TO BID

1.1 PROJECT INFORMATION

- A. Notice to Bidders: [**Prequalified**] [**Qualified**] bidders are invited to submit bids for Project as described in this Document according to the Instructions to Bidders.
- B. Project Identification: <Insert Project identifier such as Project name and number>.
 - 1. Project Location: <Insert Project location (street address, city, and state)>.
- C. Owner: <Insert name and address of Owner>.
 - 1. Owner's Representative: <Insert name and contact information for Owner's representative>.
- D. Architect: <Insert name and contact information for Architect>.
- E. Construction Manager: <Insert name and contact information for Construction Manager>.
- F. Design-Builder: <Insert name and contact information for Design-Builder>.
- G. Project Description: Project consists of <Insert brief description of Project scope>.
- H. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).
 - 2. Multiple Contract Project consisting of the following prime contracts:
 - a. General Building Construction.
 - b. Plumbing Construction.
 - c. Mechanical Construction.
 - d. Electrical Construction.
 - e. <Insert name of prime contract>.

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: <Insert date>.
 - 2. Bid Time: [**2:00 p.m.**] <Insert time>, local time.
 - 3. Location: <Insert bid receipt's location and room name>, <Insert street address>, <Insert city, state, and zip code>.
- B. Bids will be thereafter [**privately opened**] [**opened in the presence of the bidders and read aloud**] [**publicly opened and read aloud**].

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid in the amount of [**5**] <Insert number> percent of the bid amount. No bids may be withdrawn for a period of [**60**] <Insert number> 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 <Insert location> on <Insert date> at [10:00 a.m.] <Insert time>, local time. Prospective bidders are [requested] [required] to attend.

1.5 DOCUMENTS

- A. Printed Procurement and Contracting Documents: Obtain after <Insert date> by contacting <Insert Owner, Architect, or reprographic house address>. Documents will be provided to prime bidders only; only complete sets of documents will be issued.

1. Deposit: [\$100.00] <Insert amount>.
2. Shipping: Additional shipping charges of <Insert amount> will apply.

- B. Online Procurement and Contracting Documents: Obtain access after <Insert date> by contacting <Insert Owner, Architect, or reprographic house address>. Online access will be provided to [prime bidders only] [all registered bidders and suppliers].

1.6 TIME OF COMPLETION[AND LIQUIDATED DAMAGES]

- A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.[Work is subject to liquidated damages.]

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 001116

DOCUMENT 002213 - 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"
 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 the state of North Carolina 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] [Construction Manager].

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.

4. Add Section 4.1.10:

- a. 4.1.10 - Bids shall include sales and use taxes. Contractors shall show separately with each monthly payment application the sales and use taxes paid by them and their subcontractors in the form indicated. Reimbursement of sales and use taxes, if any, shall be applied for by Owner for the sole benefit of Owner.

B. 4.3 - Submission of Bids:

1. Add Section 4.3.1.2:

- a. 4.3.1.2 - Include Bidder's Contractor License Number applicable in Project jurisdiction on the face of the sealed bid envelope.

C. 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.

D. 4.6 - Subcontractors, Suppliers, and Manufacturers List Bid Supplement:

1. Add Section 4.6:

- a. 4.6 - Provide list of major subcontractors, suppliers, and manufacturers furnishing or installing products on forms provided no later than two business days following Architect's request. Include those subcontractors, suppliers, and manufacturers providing work totaling three percent or more of the Bid amount. Do not change subcontractors, suppliers, and manufacturers from those submitted without approval of Architect.

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 6 - POSTBID INFORMATION

A. 6.1 - Contractor's Qualification Statement:

1. Add Section 6.1.1:

- a. 6.1.1 - Submit Contractor's Qualification Statement no later than two business days following Architect's request.

B. 6.3 - Submittals:

1. Add Section 6.3.1.4:

- a. 6.3.1.4 - Submit information requested in Sections 6.3.1.1, 6.3.1.2, and 6.3.1.3 no later than two business days following Architect's request.

1.8 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.

1.9 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 or the date that the Bidder is obligated to deliver the executed Agreement and required bonds to Owner.
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 002213

DOCUMENT 002513 - PREBID MEETINGS

1.1 PREBID MEETING

- A. **[Owner] [Architect] [Construction Manager]** will conduct a Prebid meeting as indicated below:
1. Meeting Date: **<Insert date>**.
 2. Meeting Time: **[2:00 p.m.] <Insert time>**, local time.
 3. Location: **<Insert meeting location and room name>**, **<Insert street address>**, **<Insert city, state, and zip code>**.
- B. Attendance:
1. Prime Bidders: Attendance at Prebid meeting is **[recommended] [mandatory]**.
 2. Subcontractors: Attendance at Prebid meeting is recommended.
 3. Notice: Bids will only be accepted from prime bidders represented on Prebid Meeting sign-in sheet.
- C. Bidder Questions: Submit written questions to be addressed at Prebid meeting minimum of two business days prior to meeting.
- D. 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. Bidder Qualifications.
 - d. Bonding.
 - e. Insurance.
 - f. Bid Security.
 - g. Bid Form and Attachments.
 - h. Bid Submittal Requirements.
 - i. Bid Submittal Checklist.
 - j. Notice of Award.
 2. Communication during Bidding Period:
 - a. Obtaining documents.
 - b. Access to Project Web site.
 - c. Bidder's Requests for Information.
 - d. Bidder's Substitution Request/Prior Approval Request.
 - e. Addenda.
 3. Contracting Requirements:
 - a. Agreement.
 - b. The General Conditions.
 - c. The Supplementary Conditions.
 - d. Other Owner requirements.
 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.
- E. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees and others known by the issuing office to have received a complete set of Procurement and Contracting Documents. 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 002513

DOCUMENT 004373 - PROPOSED SCHEDULE OF VALUES FORM

1.1 BID FORM SUPPLEMENT

- A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.2 PROPOSED SCHEDULE OF VALUES FORM

- A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of [**five**] <**Insert number**> percent of the Contract Sum.
- B. Arrange schedule of values using [**AIA Document G703-1992**] <**Insert name and designation of standard form**>.
 - 1. Copies of AIA standard forms may be obtained from the American Institute of Architects; <https://www.aiacontracts.org/library>; (800) 942-7732.

END OF DOCUMENT 004373

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFCD) products.
4. Owner-furnished/Owner-installed (OFOI) products.
5. Contractor's use of site and premises.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: New Hanover County Substance Abuse Facility

1. Project Location: 1605 Robin Hood Road, Wilmington, NC 28401

B. Owner: New Hanover County

1. Owner's Representative: Kevin Caison, (910) 798-4338, kcaison@nhcgov.com

C. Architect: LS3P, 101 N. Third Street, Suite 500, Wilmington, NC 28401; Phone: 910.790.9901.

1. Architect's Representative: Charles Boney Jr. (910) 397-3627, charlesboney@ls3p.com.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineering
 - a. Wood Engineers, Adam Sisk, (910) 343-8007
2. Civil Engineering
 - a. Paramounte Engineering, Robert Balland, (910) 791 6707
3. Mechanical/Electrical/Plumbing/Fire Safety:
 - a. Newcomb and Boyd, Paul Kitchens, (919) 783-7812

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. The project consist of a Renovation (Level 2) based on the 2018 North Carolina Building Code. The renovated occupancy will be I-2/R-2, Type II-B Construction, fully sprinkled with standpipes, The renovated total affected building area is 14,100sf and shall be coordinated between all necessary trades and other Work indicated in the Contract Documents.

1.4

A. Type of Contract:

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

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFICI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFICI) Products:

1. All scope of work identified in the Contract Documents as **"OFICI"** and indicated as such herein.

1.6 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. The Owner will furnish and install products indicated.

B. Owner-Furnished/Owner-Installed (OFOI) Products:

1. All scope of work identified in the Contract Documents as **"OFOI"** and indicated as such herein.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Each 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.

B. Restricted Use of Site: Each Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits on Use of Site: Confine construction operations to the designated "Limits of Construction" in the Contract Documents

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2. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
- a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.
- 1.8 WORK RESTRICTIONS
- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: There is NO LIMIT on working hours., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
1. Weekend Hours: At the discretion of the local AHJ.
 2. Early Morning Hours: As per regulations by authorities having jurisdiction for restrictions on noisy work.
 3. Work in Existing Building: Based on times permitted and other Owner's restrictions.
 4. Hours for Utility Shutdowns: As required by Utilities.
- C. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.
- 1.9 SPECIFICATION AND DRAWING CONVENTIONS
- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Testing and inspecting allowances.
- C. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 3. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include [taxes,]freight[,] and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.10 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of testing and inspection services not specifically required by the Contract Documents are Contractor responsibilities and are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.11 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Include the sum of \$15,000.00 for Testing and Inspections. In the event New Hanover County requests an unforeseen inspection or test in addition to the tests and inspections required by the Authority Having Jurisdiction. Section 014000 "Quality Requirements."
 - 1. This allowance includes material, receiving, handling, and installation costs, and Contractor overhead and profit.
- B. Allowance No.2: Unit-Cost Allowance: Include the sum of \$350.00 per thousand for face brick repair to include removal and all materials necessary to repair deteriorated brick surfaces not indicated in the drawings, as specified in Section 042100 "Brick Masonry".
- C. Allowance No. 3: Contingency Allowance: Include a contingency allowance of \$25,000.00 for use according to the Owner's written directives.
 - 1. This allowance includes material, receiving, handling, and installation costs, and Contractor overhead and profit.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article 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. One: New Entrance Canopy
 - 1. Base Bid: No canopy exists at this location.
 - 2. Alternate: **ADD** Pre-Fabricated Metal Canopy as indicated on the Contract Drawings and as specified in Section 10 7300 Protective Covers.
- B. Alternate No. Two: Decorative Fence at RHA Courtyard.

1. Base Bid: 8'-0" Wooden "Shadowbox" fence as per Architectural Sheet A-202
 2. Alternate: **ADD** Decorative Metal Channel and Wood Plank as indicated in the Contract Documents and Project Manual.
- C. Alternate No. Three: Eliminate Courtyard Fence at LINC side
1. Base Bid: Wooden Screen Fence as indicated by the Contract Documents.
 2. Alternate: **DEDUCT** the scope (materials and labor) associated with the exclusion of the designated screen fence as indicated by the Contract Documents.
- D. Alternate No. Four: Metal Roof Panels - Recoating
1. Base Bid: Existing roof to remain, roof coating system to include gutters and extend to nearest roof fasteners.
 2. Alternate: **ADD** scope (Materials and Labor) to clean, prepare, and repaint the metal roof panels, including coating the roof edges and through the gutter system, as per the contract Documents and as specified in Section 09 9100 PAINTING.
- E. Alternate No. Five: Sink Vanity at RHA Bathroom
1. Base Bid: Integrated Vanity Fixture
 2. Alternate: **ADD** upgraded Sink Vanity as indicated in the Plumbing Drawings and as specified in Section 22 4216.16 Commercial Sinks.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Consultant will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Consultant 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 Consultant are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 7 days 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 Owner and Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use a form acceptable to Consultant.
- 1.1 ADMINISTRATIVE CHANGE ORDERS
- A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.
- 1.2 CHANGE ORDER PROCEDURES
- A. On Owner's approval of a Work Changes Proposal Request, Consultant will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 form included in Project Manual.
- 1.3 EXTENSIONS
- A. General: This article establishes conditions and procedures for amending the Contract Time when excess adverse weather conditions have repeatedly caused cancellation of schedule critical activities, resulting in delay to the Project.
- B. Definitions:
1. Adverse Weather: Job site environmental conditions in which precipitation, or soil conditions resulting from precipitation, or ambient temperature conditions during working hours preclude carrying out a Scheduled Critical Activity. The following conditions may be considered by the Architect in determining the extent of excess adverse weather conditions, depending upon the nature of the delayed project tasks:
 - a. Precipitation greater than 0.10 inch of water equivalent per day.

- b. Days on which the average air temperature does not exceed 40 degrees F.
- c. Other weather conditions deemed hazardous by the Contractor.

C.

- 1. Scheduled Critical Activity: Project tasks, the delay of which will directly result in a delay in the completion of the project.
- 2. Excess Adverse Weather: Adverse weather occurring in excess of the normal, cumulative number of calendar days of adverse weather as listed below:
- 3.

| 4. Month | 5. Normal | 6. Month | 7. Normal |
|--------------|-----------|---------------|-----------|
| 8. January | | 9. July | 10. |
| 11. February | | 12. August | 13. |
| 14. March | | 15. September | 16. |
| 17. April | | 18. October | 19. |
| 20. May | | 21. November | 22. |
| 23. June | | 24. December | 25. |
| 26. Total | | 28. | 31. |
| 27. Annual | | 29. _____ | |
| Days | | 30. DAYS | |
| Allowed For | | | |
| Project | | | |

32.

D. Claim for Extension of Time Due to Weather:

- 1. Contractor shall file claim for each month during which adverse weather occurs.
 - a. Attach copies of Contractor’s Daily Reports for each day of adverse weather, describing fully the weather conditions, schedule activities delayed, and reasons for the delay.
 - b. Include photographs where applicable for documenting soil conditions.
 - c. Attach copy of NCDC/NOAA Local Climatological Data report for given month, or other published U.S. or state monthly weather data acceptable to Architect.
- 2. Claim shall be filed for a calendar month by attaching the completed form to the Application for Payment submitted the following month.
- 3. Architect shall review and approve or take other action upon Contractor’s Claim for Extension of Time. Adjustment of Contract Time shall be made by a single Change Order prepared at project closeout.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - 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 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

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.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
12. 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 Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the **FIRST DAY** of the month. The Architect will, within three days, forward the Payment Application to the Owner for

processing. The period covered by each Application for Payment is one month, ending on the last day of the month. It is acceptable for the GC to reasonably forecast the last week (7 Days Maximum) of the current Pay Period.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. 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.
- F. 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.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. A COMPLETE and properly signed Electronic format Payment Application will be acceptable.
 2. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
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.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- J. Subsequent Application for Payment: After issuing the Initial Application for Payment, administrative actions and submittals that must precede or coincide with submittal of remaining Applications for Payment include the following:
1. Reports and other documents indicated in Division 01 Section "Construction Progress Documentation."
 2. Closeout Submittal List (preliminary, if not final).
- K. Retainage Reduction:
1. Owner shall pay the amount due to the Contractor on account of progress payments as indicated in the Agreement. After completion of a percentage of the Work, as agreed, the Contractor shall submit, for Owner's and Architect's review and approval a written request for retainage reduction. Upon Owner's approval, with written consent of the surety, the Architect may certify remaining partial payments to be paid in full.
 2. The Contractor, as a condition precedent to retainage reduction shall submit, for review and approval by the Architect, the required O&M manual.
- L. Application for Payment at Final Acceptance: After Architect issues the Certificate of Final Acceptance, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- M. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.
 12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - 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. Project Information Management System (NewForma)
 4. RFIs.
 5. Project meetings.
- B. Related Requirements:
1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.2 INFORMATIONAL SUBMITTALS

- A. Submit all Informational Submittals to the Owner and the Architect
- B. 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.
- C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.3 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 assure proper performance of components, 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.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 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 in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to verify that components requiring coordination have been included, 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.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures" and post to Project Information Management System.
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

- D. 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. 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. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

1.5 NEWFORMA PROJECT INFORMATION MANAGEMENT SYSTEM

- A. The Architect has established a web-based Project Information Management System to facilitate communication and record-keeping during the project. Architect will provide access to Contractor's key personnel.
1. Use Architect's web-based Project Information Management System (NEWFORMA) for purposes of managing project communication and documentation until Final Completion.
 2. Due to the size restrictions on email communication, all electronic files must be submitted through the Project Information Management System. Architect assumes no responsibility for information not received or retrieved by Contractor's failure to use the Project Information Management System and such loss or delay of information will not be considered as a delay claim.
- B. The Project Information Management System shall include the following:
1. Project directory.
 2. Project correspondence.
 3. Meeting minutes.
 4. Contract modifications forms and logs.
 5. RFI forms and logs.
 6. Submittal forms and logs.
 7. Architect's Supplementary Instruction forms and logs.
 8. Proposal request forms and logs.
 9. Change order forms and logs.
 10. Reminder and tracking functions.
 11. Task and issue management.
 12. Photo documentation.
 13. Schedule and calendar management.
 14. Payment application forms.
 15. Drawing and specification document hosting, viewing, and updating.
 16. Online document collaborations.
 17. Archiving function.
- C. Contractor, subcontractors, and other parties granted access by Contractor to Project Information Management System shall execute a data licensing agreement in the Form of Agreement included in this Project Manual.

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 via the Project Information Management System.

1. Architect will not respond to those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form within Project Information Management System
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 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 not be reviewed:
 - a. Requests for approval of Contractor's means and methods.
 - b. Requests for coordination information already indicated in the Contract Documents.
 - c. Requests for adjustments in the Contract Time or the Contract Sum.
 - d. Requests for interpretation of Architect's actions on submittals.
 - e. Incomplete RFIs or inaccurately prepared RFIs.
 2. Requests for approval of Submittals and Substitutions by a generated RFI will not be allowed.
 - 3.
 4. 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.
 - 5.
 6. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

- E. RFI Log: The Project Information Management System will create and maintain the RFI log.
- F. On receipt of Architect's action, immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 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 discussions and agreements achieved. Distribute the meeting minutes to attendees, including Owner[, ,] and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises
 - 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.

- dd. Bonds and insurance.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

- a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at properly established 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) Status of submittals.
 - 4) Status of sustainable design documentation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.

- 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
4. Minutes: 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.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of RFIs.
 - 14) Proposal Requests.
 - 15) Change Orders.
 - 16) Pending changes.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Startup construction schedule.
 2. Contractor's Construction Schedule.
 3. Construction schedule updating reports.
 4. Daily construction reports.
 5. Material location reports.
 6. Site condition reports.
 7. Unusual event reports.
- B. Related Requirements:
1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 3. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at monthly intervals.
- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the

preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing work stages area separations interim milestones partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant to attend all meetings related to Project progress, alleged delays, and time impact.
- C. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 35 days, unless specifically allowed by Architect.
 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes, and samples.
 - d. Owner interfaces and furnishing of items.

- e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.

- c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect and Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.7 GANTT-CHART SCHEDULE REQUIREMENTS
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.
1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.
 2. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. Activities occurring following Final Completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost to reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities to equal the total Contract Sum.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediately preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.

8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.8 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Time-lapse sequence construction photographs.
5. Final Completion construction photographs.
6. Preconstruction video recordings.
7. Periodic construction video recordings.
8. Time-lapse sequence construction video recordings.
9. Construction webcam.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.3 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.
- B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera megapixels and capable of recording in full high-definition mode. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time from camera.
- E. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
- E. Periodic Construction Photographs: Take photographs to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take after date of Substantial Completion for submission as Project Record Documents.
- G. Maintain cameras and web-based access in good working order, in accordance with web-based construction photographic documentation service provider's written instructions until Final Completion. Provide for service of cameras and related networking devices and software.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Electronic Files Transfer: Use Architect's web-based Project Information Management System specifically established for Project for submittals containing electronic files. Refer to Section 013100 "Project Management and Coordination" for additional information on the Project Information Management System.

1. The web address or hyperlink will be provided at initial preconstruction conference.
2. The Architect assumes no responsibility for information lost or not received by Contractor's failure to submit and retrieve through the Project Information Management System.
3. Contractor's failure to submit and retrieve through the Project Information Management System will not be considered in delay claims associated with lost or missing information.

C. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: Verify with Architect for software program used for Drawings.
 - 2. The digital data files are available under the following conditions:

- a. Contractor shall execute a data licensing agreement in the form of Digital Data Letter of Agreement included in the Project Manual.
- b. Digital data drawings are not considered Contract Documents as defined by the General Conditions for the Contract for Construction.
- c. The Contract Documents executed or identified in the Owner/Contractor Agreement, shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations involving computers.
- d. The Contractor shall not transfer or reuse Instruments of Service in electronic or machine-readable form without the prior written consent of the Architect.

1.5 SUBMITTAL FORMATS

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

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Procedures: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Project Information Management System (Newforma): Prepare submittals in PDF form, and upload to Architect's Project Information Management System. Enter required data to fully identify submittal.

- 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 joint consultant reviews and Contractor 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 sequential reviews and resubmittals.
1. Initial Review: Allow 7 Days (12 days for Consultants) 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 7 Days (12 days for Consultants) for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 10 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- 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.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Project Information Management System: Prepare submittals in PDF form, and upload to Architect's Project Information Management System. Enter required data to fully identify submittal.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - 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.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 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 paper copies 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.
 - 2.

1.9 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.
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, checked, and approved for compliance with the Contract Documents.

1.10 ARCHITECT'S REVIEW

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return. Architect will stamp each submittal with an action stamp and will mark appropriately to indicate action, as follows:
 - 1. Action Stamp Notations:
 - a. No Exceptions Taken: The work covered by the submittal may proceed.
 - b. Note Markings: The work covered by the submittal may proceed provided it complies with both the Architect's notations and corrections on the submittal and the Contract Documents.
 - c. Rejected: Do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.
 - 2. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action
- C. 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.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Architect will return without review submittals received from sources other than Contractor.
- G. Submittals not required by the Contract Documents will be returned by Architect without action, with notation "No Action Taken."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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DIGITAL DATA LETTER OF AGREEMENT

An Agreement Between the Architect and _____ (the "Transferee," either Original or Third Party, as the case may be) for Transfer of Digital Data

| | | |
|-------------------|----------------------|-----------------------|
| Architect: | LS3P | Transferee: |
| | <Office Address> | Original |
| | <Office City, State> | 3 rd Party |
| | Contact: | |

Contract No.:
Project No.: **Project Name:**
Location:
Date:

The Architect will provide the following Digital Data, dated as of the particular transmission, to the Transferee **for information purposes only:**

Digital Data was prepared using the following:

| | | |
|------------------|---------------------|-----------------|
| Software: | AutoCAD (.dwg) | Version: |
| | MicroStation (.dgn) | |
| | Revit (.rvt) | |

Digital Data to be delivered via the following media: Newforma Website posting

Transferee shall pay the Architect a service fee of \$_____ and other good and valuable consideration.

TERMS AND CONDITIONS

1. The Architect and its consultants make no representation as to the compatibility of the Digital Data with any hardware or software. The Transferee shall notify the Architect within five (5) business days of any problems associated with accessing and/or using the Digital Data.
2. The Transferee acknowledges and agrees that the Digital Data can be modified unintentionally or otherwise. The Transferee acknowledges and agrees that the Architect and its consultants may remove all indications of ownership from the Digital Data prior to transmission.
3. All Digital Data shall be considered the property of the Architect and/or its consultants and shall not be used for other Projects, for additions to this Project, or for completion of this Project without the prior written permission of the Architect and/or its consultants. Digital Data shall not be re-transmitted by the Original Transferee to a Third Party Transferee without prior execution of an agreement identical to this Agreement between the Architect, the Original Transferee, and the Third Party Transferee. Under no circumstances shall the transmission of the Digital Data be considered a sale of goods or a sale of copyrights.
4. **THE ARCHITECT AND THE ARCHITECT'S CONSULTANTS HEREBY EXPRESSLY DISCLAIM ANY AND ALL WARRANTIES, BOTH EXPRESS AND IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AS WELL AS ANY WARRANTY OF ACCURACY, COMPLETENESS,**

AND/OR PERMANENCE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. Addenda information and/or revisions made to the most current Digital Data after any date of transmission may not have been incorporated into the transmitted Digital Data. The Architect may update the Digital Data and give notice to authorized parties (or not) as is consistent with the Architect's professional skill and care and the orderly progress of the Work. In the event of a conflict between the Architect's printed instruments of service (whether sealed or not) and the Digital Data, the printed instruments of service shall govern. The Transferee acknowledges and agrees that the duty to determine the existence of any and all conflicts between the Digital Data and any other information upon which the Transferee relies rests solely upon the Transferee. The Digital Data shall not be considered Contract Documents or Construction Documents as defined by any General Conditions of Contract for Construction. The Digital Data is being provided on a strictly "AS IS" basis.

5. The use and/or provision of the Digital Data prepared by the Architect and/or its consultants shall not in any way reduce or obviate the Transferee's duty to check and coordinate dimensions, details, and quantities of materials as required to facilitate construction of the Project. Confirmation of existing conditions is the sole responsibility of the Transferee.

6. The Transferee agrees to the extent permitted by applicable law, to indemnify, hold harmless, release, and defend the Architect and/or its consultants, their officers, shareholders, employees, and sub-consultants from any and all injuries, claims, demands, expenses, suits, liabilities, losses, damages, costs, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses related to the Digital Data, including but not limited to, attorneys' fees, expert witness fees, and court costs arising out of or in any way related to or connected with any negligent act and/or omission in the generation, provision, and/or use of the Digital Data by the Transferee and/or any of its subcontractors, suppliers, and/or consultants and waive any and all rights to such claims and causes of action.

7. The Transferee waives damages against the Architect for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, and/or claim expenses arising out of or relating to this Agreement and/or generation, provision, and/or use of the Digital Data, including, but not limited to, consequential damages and reasonable attorneys' fees and defense costs.

8. The Architect's and/or the Architect's consultants' liability to the Transferee and/or any of its subcontractors, suppliers, and/or consultants for any and all injuries, claims, losses, expenses, damages, disputes, other matters in question, third party claims, pass-through claims, subrogated claims, and/or claim expenses arising out of or relating to this Agreement and/or the Digital Data, including, but not limited to, reasonable attorneys' fees and defense costs, regardless of the nature of the claim or damage, shall not exceed, either individually or in the aggregate, the total amount of \$1,000.00. Such causes include, but are not limited to, the Architect's and/or the Architect's consultants' negligence, errors, omissions, strict liability, breach of contract, and/or breach of warranty.

9. Upon information and belief, there are no licensing or copyright fees due to others based on the transmission of the Digital Data, but to the extent that such unknown fees do exist, the Transferee agrees to pay the required fees and hold the Architect and/or its consultants harmless from any associated costs or penalties.

10. Upon execution of this Agreement, the Architect grants to the Transferee a non-exclusive, non-transferable (except as set forth herein) license to use the Digital Data solely and exclusively for informational purposes only, provided that the Transferee substantially performs its obligations, including prompt payment of all sums when due, under this Agreement.

11. Any purchase order number provided by the Transferee is for the Transferee's accounting purposes only. The Transferee acknowledges and agrees that purchase order terms and conditions are null, void, and inapplicable to this Agreement.

12. Payment of the service fee set forth herein is due prior to transmission of the Digital Data.

13. This Agreement constitutes the entire agreement between the parties relative to the Digital Data and shall be governed by the laws of the State of <North Carolina><South Carolina><Georgia>.

AUTHORIZED ACCEPTANCE

by Architect:
LS3P

Signature

Print Name and Title

Date

by Original Transferee:

Signature

Print Name and Title

Date

by Third Party Transferee:

Signature

Print Name and Title

Date

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SECTION 014000 - 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, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 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.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

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

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

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

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. **Contractor's Responsibilities:**
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 2. **Testing Agency Responsibilities:** Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. **Mockups:** Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
 3. Notify Architect in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 10. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

- A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances specified in Section 012100 "Allowances," as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

END OF SECTION 014000

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SECTION 015000 - 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 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to 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, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use with metering. Provide connections and extensions of services and metering as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use with metering. Provide connections and extensions of services and metering as required for construction operations.
- G. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

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. Implementation and Termination Schedule: No later than the date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste-handling procedures.
 5. Other dust-control measures.

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.
- C. Accessible Temporary Egress: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design".

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. Fencing: At the Contractors Option, provide temporary fencing to secure the job site during Construction as per:
1. 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 rails.
 - 2.
 3. 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 concrete or galvanized-steel bases for supporting posts.

- 4.
 5. Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- B. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, 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. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "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.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers as directed by authorities having jurisdiction.
- C. Water Service:
 - 1. Install water service and distribution piping in sizes and pressures adequate for construction.

2. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service:
1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
 2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - a. Install electric power service overhead unless otherwise indicated.
 - b. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- 3.4 SUPPORT FACILITIES INSTALLATION
- A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 2. Utilize designated area within existing building for temporary field offices.
 3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved

areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- F. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- H. 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.
- I. Waste Disposal Facilities:
1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
 2. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

- M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

- C. Temporary Erosion and Sedimentation Control:

1. Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
2. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- E. Tree and Plant Protection:

1. Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
2. Install temporary protective barricade located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

- G. 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.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.

- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - a. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
1. Construction layout.
 2. Field engineering.
 3. Installation.
 4. Cutting and patching.
 5. Coordination of Owner's portion of the Work.
 6. Progress cleaning.
 7. Starting and adjusting.
 8. Protection of installed construction.
 9. Correction of the Work.
- B. Related Requirements:
1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
 2. Section 013300 "Submittal Procedures" for submitting surveys.
 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by professional engineer, certifying that location and elevation of improvements comply with requirements.
- B. Cutting and Patching Plan: Submit plan describing procedures prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety **to include the following:**
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.

- c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 - m.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4.
 5. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence

and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

- b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 044313.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 4. Section 044313.16 "Adhered Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 5. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For waste management coordinator and.
- H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- I. Refrigerant Recovery: Comply with requirements in Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may not serve as Waste Management Coordinator.

- B. Refrigerant Recovery Technician Qualifications: Universal certified by EPA-approved certification program.
- C. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024119 "Selective Demolition."
- D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
 - 1. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling as per the direction of the by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials , including the following:
 - 1. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.

- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL
- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 4-inch size.
 2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 1. Pulverize masonry to maximum 4-inch size.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- E. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- F. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- I. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- J. Carpet Tile: Remove debris, trash, and adhesive.
 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- K. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- L. Conduit: Reduce conduit to straight lengths and store by material and size.
- M. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Final Acceptance procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Final Acceptance and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Final Acceptance.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 FINAL ACCEPTANCE PROCEDURES

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

- B. Submittals Prior to Final Acceptance: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Final Acceptance. 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 Final Acceptance.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. 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.

- D. Inspection: Submit a written request for inspection to determine Final Acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Final Acceptance 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.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Final Acceptance inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect will return annotated file.

- b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Final Acceptance, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. 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.

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 Final Acceptance for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. 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. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. 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.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Final Acceptance.

END OF SECTION 017700

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SECTION 017823 - 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. Emergency manuals.
 3. Systems and equipment operation manuals.
 4. Systems and equipment maintenance manuals.
 5. Product maintenance manuals.
- B. Related Requirements:
1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
 4. Section 260010 "Supplemental Requirements for Electrical" for requirements for Electrical Preventative Maintenance (EPM) Program binders that form part of the operation and maintenance data of this Section and include additional requirements for operation, maintenance, and emergency procedures, for electrical systems and equipment.

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. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.
- 1.4 **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 to 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 Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. 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.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- 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 in accordance with 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 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.8 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. 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.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and

service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 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

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
 - 2. Section 017300 "Execution" for final property survey.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
 - 3) Submit Record Digital Data Files and one set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned Record Prints
 - 3) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 - 1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.

2. Format: Annotated PDF electronic file with comment function enabled.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect through Construction Manager for resolution.
5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

1.5 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, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 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 and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
5. Section 330500 "Common Work Results for Utilities" for removal of site utility systems piping, equipment, and components.

1.2 REFERENCES

A. Definitions

1. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
3. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
4. Existing to Remain: Existing items of construction that are not to be removed.

1.3 ADMINISTRATIVE REQUIREMENTS

A. MATERIALS OWNERSHIP

1. Unless otherwise indicated, demolition waste becomes property of Contractor.
2. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
3. Carefully salvage in a manner to prevent damage and promptly return to Owner.

B. COORDINATION

1. Arrange selective demolition schedule so as not to interfere with Owner's operations.

C. PREINSTALLATION MEETINGS

1. Pre-demolition Conference: Conduct conference at a location determined by the Owner.

- a. Inspect and discuss condition of construction to be selectively demolished.
- b. Review structural load limitations of existing structure.
- c. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
- d. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
- e. Review areas where existing construction is to remain and requires protection.
- f. Review and finalize protection requirements.
- g. Review procedures for noise control and dust control.
- h. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.4 ACTION SUBMITTALS

- A. Qualification Statements: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Survey of Existing Conditions: Submit survey.
- D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property[, **for environmental protection**] [, **for dust control**] [**and**] [, **for noise control**]. Indicate proposed locations and construction of barriers.
- E. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- H. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01. Submit before Work begins.
- I. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 1. Comply with submittal requirements in Division 01.
- J. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241

1.7 PROJECT CONDITIONS

- A. Owner may occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove those items listed in the documents and during the preconstruction meeting.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. On-site sale of removed items or materials is not permitted.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.
 - 1. Comply with requirements specified in Division 01.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

- a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Division 01.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering, and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area as designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Reinforce Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Burning of demolished materials will be permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

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SECTION 032000 - CONCRETE REINFORCING**PART 1 GENERAL****1.1 SUMMARY****A. Scope**

1. Provide all materials, equipment, transportation, and facilities, and perform labor necessary for the installation of all concrete reinforcing as shown on the drawings. Comply with all recommendations of soils and structural engineer's specification regarding protection from corrosive soils or soils containing sulfates and expansive soils.

B. Related Requirements

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of the Specifications.
 - a. Section 014100 - Structural Testing Laboratory Services
 - b. Section 033000 - Cast-In-Place Concrete
 - c. Section 034100 - Plant Precast Structural Concrete

1.2 REFERENCES**A. Reference Standards**

American Concrete Institute

ACI 318, Building Code Requirements for Reinforced Concrete

ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures

American Society for Testing and Materials

ASTM A185 Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement.

ASTM A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

ASTM A706 Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement.

ASTM A153 Standard Specification for Zinc Coating (Hot-dip) on Iron and Steel Hardware.

ASTM E-1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-number System."

AWS D1.4, "Structural Welding Code"

Concrete Reinforcing Steel Institute, CRSI, Manual of Standard Practice

1.3 COORDINATION

- A. Coordinate the Work of this Section with other interfacing work in direct contact with the products listed herein. Consult with manufacturer for compatibility of materials specified in other sections that will be in contact with the products listed in this Section.

1.4 SUBMITTALS

- A. Shop Drawings

1. Submit shop drawings and installation drawings for all foundations for review by the Structural Engineer. Shop drawings shall indicate details of bending, bar lengths, and placement requirements, and methods and hardware for support and spacing of bars.
2. Notes given on Drawings relating to placement of bars shall be reproduced on installation drawings.
3. Review of shop drawings will be for bar sizes, spacings, and general detail only. Quantities, lengths, and fit of materials are Contractor's responsibility.

B. Test Reports

1. Mill Test Reports: Certified copies, evidencing compliance with the requirements of Specifications, shall be delivered to Structural Engineer with the deliveries of reinforcing steel.
2. Submit copies of laboratory testing and inspection reports in accordance with the Section 014100.

1.5 QUALITY ASSURANCE

- A. Contractor will be held to have carefully examined all of the Contract Documents including all pertinent details prior to construction of forms for the various parts of the buildings.
- B. Pre-installation Conference shall be scheduled at least 7 days prior to beginning concrete work. The meeting attendees shall include the General Contractor, Subcontractors, and Engineer to review the proposed mix designs and to discuss the required methods and procedures to produce concrete quality concrete construction. This conference will review the submittals and their approval status including the coordination of the concrete work with other trades. The Contractor and Subcontractor will have verified the availability of all materials as well as review the plan and schedule for delivering the materials to the site.

PART 2 PRODUCTS

2.1 PRODUCT, DELIVERY, STORAGE AND HANDLING

- A. Deliver reinforcement to the project site in bundles which are clearly marked with the metal tags indicating bar sizes, lengths, and designated portion of work. Bundles shall be limited to one size and one length, and each bundle shall be tagged with metal tags.
- B. Stockpile reinforcing off the ground in a dry area supported on wood blocking or similar to prevent contamination until it is utilized on the project. Reinforcing steel shall be stacked in tiers. Care shall be exercised to maintain reinforcement free of dirt, mud, paint, rust, and other foreign material.

2.2 MATERIALS

A. Reinforcing

1. Bars shall be new deformed billet steel conforming to requirements of ASTM A615. Grades of steel for various sizes and conditions are given on the drawings. Reinforcing Bars: ASTM A615, Grade 60, deformed bars. Epoxy coated rebar to be used at all horizontal exposed structural slabs that will be subjected to salts and at coastal areas.
2. Welded wire mesh shall conform to ASTM A185.
3. Spirals shall be smooth bars conforming to ASTM A615 Grade 60.

4. Reinforcing bars to be welded to structural steel shall conform to the ASTM A706 Grade 60.
5. Supports for Reinforcing: Bolsters Chairs, Spacers, comply with CRSI.
6. Steel Wire: ASTM A82, 16 Ga., Plain cold drawn steel.
7. Deformed Bar Anchors: ASTM A496, 75,000 PSI yield strength.
8. Dowel Bar Sleeves: Plastic, 1/16 inch larger than diameter.
9. Fiber Reinforcing: ASTM C1116, Type III, "Fibermesh" not less than 3/4 inch in length and diagnosed for secondary reinforcement of concrete slabs and proportionally mixed in concrete mix at 1 ½ bags minimum per cubic yard unless noted otherwise in accordance with the manufacturer's recommendations.

2.3 CONCRETE ACCESSORIES

- A. Concrete accessories including bar supports, chairs, and spacers shall be of cold-drawn wire and shall be fabricated in accordance with the requirements of ACI 315 Chapter 7, with heights, as required. Bar supports for concrete testing on earth shall be pre-cast concrete bricks having imbedded tie wires or shall be "individual high chairs" with welded plates on bottom as manufactured by Hohmann and Barnardm, Inc. Bar supports to be used where concrete will be exposed shall be hot-dipped galvanized or shall have plastic tips.

2.4 COATINGS

- A. Rust inhibitor for field application to metal accessories shall be "Hi-Build Epoxoline" manufactured by the Tneme Co., Kansas City, Missouri, or other material as approved by the Structural Engineer of Record (EoR), reference 01 25 13 Substitution Procedures.
- B. Hot-dip galvanizing shall conform to ASTM A153.
- C. Field repair of galvanizing shall be done with or equal to "Z.R.C. Cold Galvanizing Compound", by ZRC Chemical Products CO., Quincy, Mass, or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Reinforcing steel of sizes, shapes, lengths, spacing, and other dimensions shown shall be placed where shown on the drawings, Details of reinforcing shall conform to ACI 318.

3.2 CLEANING

- A. Reinforcement shall be thoroughly cleaned of rust, mill scale, dirt, oil or other coatings which might tend to reduce bending of reinforcing to concrete.

3.3 BENDING

- A. Bars shall be bent cold. Heating or reinforcement, or handling by makeshift methods, will not be permitted. Bars having kinks or bents not required shall not be used.

3.4 PLACING

- A. Reinforcement shall be accurately places and securely saddle tied at every other intersection with No. 18 gauge black annealed wire, and shall be rigidly held in place by means for metal chairs or spaces during placement of concrete.

- B. Bars in concrete wall shall be held in position and to proper clearance by means of concrete or metal spacers made especially for locations where spacers are required.
- C. Bars in beams and slabs shall be held to correct location during placing of concrete by spacers, chairs, or other necessary supports with the following tolerances:
 - 1. Top bars in slabs and beams
 - a. Members 8 inches deep or less: + ¼ inch
 - b. Members more than 8 inches deep but not over 2 feet deep: +1/2 inch
 - c. Members more than 2 feet deep: +1 inch
 - 2. Lengthwise of members: +2 inches
 - 3. Concrete cover to formed surfaces: +1/4 inch
 - 4. Minimum spacing between bars: ½ inch
- D. Bar supports shall not be placed against exposed faces of precast beams, columns, walls, or copings.
- E. Tie wires shall not be in contact or within 1 – ½” of exposed surfaces.
- F. Reinforcement in slabs on grade shall be statically supported on appropriate spacers, chairs, or other approved supports. Hooking and lifting of reinforcement during concrete placement will not be permitted.

3.5 TESTING

- A. Upon completion of the reinforcing placement, and prior to placing concrete materials, the Contractor shall provide an independent review of the reinforcing placement, (“pre-pour inspection), to verify that all reinforcing materials have been installed in accordance with the Contract Documents.
- B. A verbal approval of the reinforcement installation must be provided to the General Contractor prior to pouring the concrete. Any nonconforming items must be corrected prior to pouring concrete.
- C. A written pre-pour inspection report must be filed with the General Contractor, Architect, Structural Engineer, and the Owner, within two weeks of the observation, indicating that all reinforcing materials were installed substantially in accordance with the requirements of the contract documents.
- D. The pre-pour inspection for all “structural” concrete shall be performed by the Structural Engineer, Testing Laboratory, or other sources approved in writing by the Engineer.
- E. The pour-inspection for all “nonstructural” concrete, (paving and flatwork), may be performed by the Structural Engineer, Testing Laboratory, General Contractor or other sources approved in writing by the Engineer.

END OF SECTION

SECTION 040120.63 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Repairing brick masonry.
- 2. Removing abandoned anchors.
- 3. Painting steel uncovered during the work.

B. Related Requirements:

- 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.

1.3 ALLOWANCES

- A. Allowances for brick masonry repair are specified in Section 012100 "Allowances."
- B. Preconstruction testing is subject to the testing and inspecting allowance.
- C. Patching brick masonry and Abandoned anchor removal are part of ALLOWANCE #2.

1.4 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.
- C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of bricks to freezing and thawing.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to brick masonry repair including, but not limited to, the following:
 - a. Verify brick masonry repair specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Materials, material application, sequencing, tolerances, and required clearances.
 - c. Quality-control requirements

- d. Coordination with any/all associated trades.

1.6 SEQUENCING AND SCHEDULING

- A. Order sand and gray portland cement for colored mortar immediately after approval. Take delivery of and store at Project site enough quantity to complete Project.
- B. Work Sequence: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:
 1. Remove plant growth.
 2. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
 3. Remove paint.
 4. Clean masonry.
 5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
 6. Repair masonry, including replacing existing masonry with new masonry materials.
 7. Rake out mortar from joints to be repointed.
 8. Point mortar and sealant joints.
 9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
 10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.
- C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks according to "Brick Masonry Patching" Article. Patch holes in mortar joints according to Section 040120.64 "Brick Masonry Repointing."

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include recommendations for product application and use.
- B. Shop Drawings:
 1. Include plans, elevations, sections, and locations of replacement bricks on the structure, showing relation of existing and new or relocated units.
 2. Show provisions for expansion joints or other sealant joints.
 3. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
 4. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.
- C. Samples for Initial Selection: For the following:
 1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.
 2. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
 3. Include similar Samples of accessories involving color selection.

- D. Samples for Verification: For the following:
1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
 2. Each type of patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
 3. Accessories: Each type of accessory and miscellaneous support.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For brick masonry repair specialist.
- B. Preconstruction Test Reports: For existing bricks and mortar and replacement bricks.
- C. Quality-control program.

1.9 QUALITY ASSURANCE

- A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.
 1. Field Supervision: Brick masonry repair specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.
- B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.
- C. Mockups: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.
 1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bricks to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.
- B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store sand where grading and other required characteristics can be maintained and contamination avoided.
- F. Handle bricks to prevent overstressing, chipping, defacement, and other damage.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits: Repair brick masonry only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
- C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:
 - 1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
 - 2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.
- D. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.
- E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

- A. Face Brick: As required to complete brick masonry repair work.
1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.
 - a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
 2. Brick Matching Architect's Sample: Units with colors, color variation within units, surface texture, and physical properties that match Architect's sample. Match existing units in size and shape.
 - a. For Architect's sample that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range rather than brick that matches an individual color within that range.
 3. Special Shapes:
 - a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
 - c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.
 4. Tolerances as Fabricated: According to tolerance requirements in ASTM C216, Type FBX.
- B. Building Brick: ASTM C62, of same vertical dimension as face brick, for masonry work concealed from view.
1. Grade SW where in contact with earth.
 2. Grade SW, MW, or NW for concealed backup.

2.3 MANUFACTURED REPAIR MATERIALS

- A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.

2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
3. Formulate patching compound in colors and textures to match each brick being patched. Provide no fewer than three colors to enable matching of the color, texture, and variation of each unit.

2.4 MASONRY ANCHORING (REMEDIAL)

- A. Helical ties: Provide an in-plane flexible connection between wythes of material, while maintaining a threaded connection to resist out-of-plane loading for both tension and compression resistance.
1. Material:
 - a. Provide ties and anchors specified in this article that are made from materials that comply with the following, unless otherwise indicated.
 - 1) Stainless steel wire: ASTM A580/A580M, Type [304][316].
 2. Application:
 - a. Masonry veneer to solid concrete backup:
 - 1) Asymmetric Stitch-Tie by PROSOCO, Inc., 10mm diameter.
 - 2) Stitch-Tie by PROSOCO, Inc., 10mm diameter.
- B.
- b. Masonry veneer to hollow CMU backup:
 - 1) Stitch-Tie by PROSOCO, Inc., 10mm diameter.
 - b. Masonry Veneer to timber backup:
 - 1) Stitch-Tie by PROSOCO, Inc., 10mm diameter.
 - c. Mass brick masonry:
 - 1) Stitch-Tie by PROSOCO, Inc., 10 mm diameter.
- C. Reinforced Grouted Helical Anchors: Provide stability to a masonry wall by filling voids in loose material by injecting thixotropic grout reinforced with a helical anchor.
1. Material:
 - a. Provide ties and anchors specified in this article that are made from materials that comply with the following, unless otherwise indicated.
 - 1) Stainless steel wire: ASTM A580/A580M, Type [304].
 - 2) Grout: BS EN 998-2.
 2. Anchor System
 - a. Grout-Tie by PROSOCO, Inc.
 - 1) 10 mm Stitch-Ties by PROSOCO, Inc.
 - 2) SureGrout S (3900 psi / 27.5 Mpa) by Sure CPS.

2.5 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, non-staining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.
- B. Masking Tape: Non-staining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

- C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
 - 1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" surface preparation according to manufacturer's literature or certified statement.
- D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
 - 1. Previous effectiveness in performing the work involved.
 - 2. Minimal possibility of damaging exposed surfaces.
 - 3. Consistency of each application.
 - 4. Uniformity of the resulting overall appearance.
 - 5. Do not use products or tools that could leave residue on surfaces.

2.6 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.
- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mixes: Mix mortar materials in the following proportions:
 - 1. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, as per Section 040513, unless otherwise indicated; with cementitious material limited to portland cement and lime masonry cement mortar cement.
 - 2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Prevent mortar from staining face of surrounding masonry and other surfaces.
 - 1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
 - 2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
 - 3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

- A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.3 ABANDONED ANCHOR REMOVAL

- A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.
 - 1. Remove items carefully to avoid spalling or cracking masonry.
 - 2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:
 - a. Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
 - b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
 - 3. Patch hole where each item was removed unless directed to remove and replace bricks.

3.4 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
 - 1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.
- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
 - 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
 - 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
 - 3. Store brick for reuse. Store off ground, on skids, and protected from weather.
 - 4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- G. Replace removed damaged brick with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

- H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 - 1. Maintain joint width for replacement units to match existing joints.
 - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
 - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
 - 2. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
 - 3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
 - 1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning", as applicable to comply with paint manufacturer's recommended preparation.
 - 2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Architect before proceeding.

3.6 BRICK MASONRY PATCHING

- A. Patch the following bricks unless another type of repair or replacement is indicated:
 - 1. Bricks indicated to be patched.
 - 2. Bricks with holes.
 - 3. Bricks with chipped edges or corners.
- B. Bricks with small areas of deep deterioration: Remove and replace existing patches unless otherwise indicated or approved by Architect.
- C. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Rinse surface to be patched and leave damp, but without standing water.
4. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
5. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
6. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
7. Keep each layer damp for 72 hours or until patching compound has set.
8. Remove and replace patches with hairline cracks or that show separation from brick at edges, and those that do not match adjoining brick in color or texture.

3.7 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
 1. Do not use metal scrapers or brushes.
 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent non-masonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Remove masking materials, leaving no residues that could trap dirt.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.
- B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.
- B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION

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SECTION 040513 – MASONRY MORTARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar for masonry at brick veneer and cast stone.
- B. Grout for masonry veneer.

1.2 RELATED REQUIREMENTS

- A. Section 042613 - Masonry Veneer: Installation of mortar and grout at masonry veneer.
- B. Section 042200 - Concrete Unit Masonry: Mortar and grout at loadbearing concrete unit masonry.

1.3 REFERENCE STANDARDS

- TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
- ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
- ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2021b.
- ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- ASTM C150/C150M - Standard Specification for Portland Cement 2021.
- ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a.
- ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar 2017.
- ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- ASTM C476 - Standard Specification for Grout for Masonry 2020.
- ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.
- ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry 2020.
- ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry 1995 (Reapproved 2013).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix for each type of mortar and grout and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
 - 1. Submit with masonry samples.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Use only one brand of cement for each type specified throughout Project.
- C. Furnish sand for brick masonry work from single source and pit, consistent in color.

1.6 PRECONSTRUCTION TESTING

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 014000 - Quality Requirements.
- B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
 - 1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.
- C. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

17 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

18 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

21 MORTAR AND GROUT APPLICATIONS

- A. Mortar Mix Designs: ASTM C270, Proportion Specification.
 1. Masonry below grade and in contact with earth: Type S.
 2. Exterior Masonry Veneer: Type N.
 3. Engineered Masonry: Type S.
 4. Exterior, Loadbearing Masonry: Type S.
 5. Exterior, Non-loadbearing Masonry and Parapet Walls: Type N.
 6. Exterior Repointing Mortar: Type O with maximum 2 percent ammonium stearate or calcium stearate per cement weight.
 7. Mortar Parge Coats; Type S or N.
 8. Interior, Loadbearing Masonry: Type N.

22 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 1. Color: Mineral pigments added as required to produce approved color sample.
 2. Manufacturers:
 - a. Essroc Italcementi Group
 - b. Holcim
 - c. Lafarge North America Inc
 - d. Lehigh Hanson
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 1. Color: Mineral pigments added as required to produce approved color sample, or as otherwise indicated on drawings.
 2. Admixtures containing calcium chloride are prohibited.
 3. Manufacturers:
 - a. Essroc Italcementi Group
 - b. Holcim
 - c. Lafarge North America Inc.
 - d. National Cement Company
 - e. Substitutions: See Section 016000 - Product Requirements.
- C. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 1. Type: Fine.

2. Manufacturers:
 - a. Amerimix, an Oldcastle brand
 - b. Substitutions: See Section 016000 - Product Requirements.
 - D. Portland Cement: ASTM C150/C150M.
 1. Type: Type I - Normal; ASTM C150/C150M. Type III may be used for cold-weather construction.
 2. Color: Standard gray.
 - E. Masonry Cement: ASTM C91/C91M.
 1. Type: Type N; ASTM C91/C91M.
 2. Colored Mortar: Premixed cement as required to match Architect's color sample.
 3. Manufacturers:
 - a. Holcim (US) Inc.
 - b. Lafarge North America Inc.
 - c. Lehigh Hanson
 - d. National Cement Company, Inc.
 - e. Substitutions: See Section 016000 - Product Requirements.
 - F. Hydrated Lime: ASTM C207, Type S.
 - G. Mortar Aggregate: ASTM C144.
 1. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 2. Colored-Mortar aggregates: Natural sand or crushed stone of color necessary to produce required mortar color as directed by Architect.
 - H. Grout Aggregate: ASTM C404.
 - I. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 1. Color(s): As indicated on drawings or as selected by Architect from manufacturer's full range.
 2. Manufacturers:
 - a. Davis Colors
 - b. Lambert Corporation
 - c. Solomon Colors
 - d. Bayferrox
 - e. Substitutions: See Section 016000 - Product Requirements.
 - J. Water: Clean and potable.
- 23 MORTAR MIXING
- A. General: Do not use admixtures, unless otherwise indicated.
 1. Do not use calcium chloride in mortar.
 2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
 - B. Ready Mixed Mortar: ASTM C1142, type equivalent to that specified according to ASTM C270.
 - C. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
 - D. Maintain sand uniformly damp immediately before the mixing process.
 - E. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
 - F. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
 - G. If water is lost by evaporation, re-temper only within two hours of mixing.
- 24 GROUT MIXING
- A. General: Do not use admixtures, unless otherwise indicated.
 1. Do not use calcium chloride in grout.

- B. Mix grout in accordance with ASTM C94/C94M.
- C. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout. Comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143/M.
- D. Add admixtures, if indicated, in accordance with manufacturer's instructions; mix uniformly.
- E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

PART 3 EXECUTION

31 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.

32 GROUTING

- A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 12 inches.
 - 2. Limit height of masonry to 16 inches above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

33 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 014000 - Quality Requirements.
- B. Test and evaluate mortar in accordance with ASTM C780 procedures.
- C. Test and evaluate grout in accordance with ASTM C1019 procedures.

END OF SECTION

accordance with manufacturer's instructions, uniform in coloration.

- F. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- A. If water is lost by evaporation, re-temper only within two hours of mixing.

12 **GROUT MIXING**

- A. General: Do not use admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in grout.
- B. Mix grout in accordance with ASTM C94/C94M.
- C. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout. Comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143/M.
- D. Add admixtures, if indicated, in accordance with manufacturer's instructions; mix uniformly.
- E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

PART 3 EXECUTION

34 **INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.

35 **GROUTING**

- A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 12 inches.
 - 2. Limit height of masonry to 16 inches above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

36 **FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 014000 - Quality Requirements.
- B. Test and evaluate mortar in accordance with ASTM C780 procedures.
- C. Test and evaluate grout in accordance with ASTM C1019 procedures.

END OF SECTION 040513

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SECTION 042100 - BRICK UNIT MASONRY

PART 1 GENERAL

1.1 REFERENCE STANDARDS

American Concrete Institute (ACI):

- 117 Standard Tolerances for Concrete Construction and Materials.
- SP66 ACI Detailing Manual.
- 530 Standard Building Code (International Building Code) 2006 Edition, with Georgia State Amendments Requirements for Masonry Structures.

American Society for Testing and Materials (ASTM):

- A82 Steel Wire, Plain, for Concrete Reinforcement.
- A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- A641 Zinc-Coated (Galvanized) Carbon Steel Wire.
- C216 Facing Brick (Solid Masonry Units Made from Clay or Shale).
- C270 Mortar for Unit Masonry.
- C652 Hollow Brick (Hollow Masonry Units Made from Clay or Shale).
- C954 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.33 in. to 0.112 in. in Thickness.
- D1056 Flexible Cellular Materials - Sponge or Expanded Rubber.
- D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

American Welding Society (AWS):

- D1.1 Structural Welding Code for Steel.

Brick Institute of America (BIA):

- Brick Institute of America, Technical Notes #20, Revised 11/1990.

1.2 SUBMITTALS

- A. General: In compliance with Section 013300 and as specified herein.
- B. Product Data: Brick manufacturer's recommended and tested masonry cleaning compound product data, mixing and application procedures.
- C. Shop Drawings: Shop Drawing submittals to be submitted and approved prior to Preinstallation Conference.
- D. Samples: Five actual brick, of each color, indicating full range of color, texture, and size (special shapes and solids) to be expected in finished Work.
- E. Certificates: Certificate, signed by manufacturer of each brick, stating quantities and dates shipped, and indicating materials supplied comply with specification requirements.
- F. Letter of Conformance; (FIO): In compliance with requirements of, and in format included in, Section 013300.

1.3 QUALITY ASSURANCE

- A. Source Limitations for Brick Masonry Units: Obtain brick masonry units of uniform texture and color, or uniform blend within ranges accepted for these characteristics, through one source from single manufacturer for each product required.
- B. Preinstallation Conference: Hold conference, after approval of specified submittal and prior to beginning brick masonry work, to review Work to be accomplished.
 - 1. Owner/Owner's Representative, Contractor, sheathing and masonry backup subcontractor, brick masonry subcontractor, brick manufacturer's representative, and all other subcontractors who have work directly affecting brick masonry shall be present.
 - 2. Contractor shall notify Architect and other attending parties minimum three days prior to time for conference.
 - 3. Contractor shall record minutes of meeting and distribute copies of minutes to attending parties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect brick masonry materials during transportation, handling, and storage.
 - 1. Store above ground on level platforms which allow air circulation under stacked units.
 - 2. Cover with heavy weatherproof coverings to prevent staining by weather, dirt, mud, oils, and grease.
 - 3. Carefully handle to prevent chipping, spalling, cracking and all other damage which impairs strength, durability, and appearance.
 - 4. Discard and remove damaged materials from Project site.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Do not lay brick masonry when temperature is below 32 F on rising temperature or below 40 F on falling temperature unless adequate precautions are taken to prevent Work from freezing.
 - 2. When Architect authorizes masonry Work during temperature below 40 F., provide mortar between temperature of 70F and 110 F.
 - 3. During freezing or near freezing weather, provide adequate equipment or cover to protect completed portions of Work and to maintain minimum temperatures above 50° F. Maintain air temperature above 40°F. on both sides of masonry minimum 48 hours after laying.

1.6 SEQUENCING AND SCHEDULING

- A. Do not enclose or cover mechanical and electrical Work until such Work has been inspected and accepted. Coordinate this masonry Work with other trades required to be built into masonry construction.

PART 2 – PRODUCTS

2.1 BRICK UNITS

- A. Face Brick: ASTM C652 or C216, Type FBS, Grade SW; modular size, 7-5/8 inches x 3-5/8 inches x 3-5/8 inches in colors as designated by the Architect.
 - 1. Brick shall match with existing conditions.

2. Brick shall be supplied by one manufacturer.
 3. Alternate manufacturers can be submitted prior to bid for review by the Architect.
- B. Special Shapes: Of same brick type as face brick, including but not limited to, special sizes, specially fabricated beveled units, beveled corner units, radial units, sill stretcher and special sill shape for soldier coursing, angled corners and 100% solid units. For sills, caps, and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide 100% solid uncured and unfrogged units with all exposed surfaces finished and provide 100% solid uncured and unfrogged units with all exposed surfaces finished at first course of brick above and below ledge angles and caulk joints. Solid units to meet ASTM C216.

2.2 ANCHORAGES AND ACCESSORIES

- A. Masonry Veneer Anchor System to Metal Stud Framing: Adjustable tie assembly consisting of strap type anchor plate, wire tie and backup plate with no mechanical play in anchor plate and backup plate in excess of 0.0625-inch and no deformation over 0.05-inch for 100 lb. load in either tension or compression.
1. Anchor Plate: Minimum 12-gauge steel strap punched for two anchors.
 2. Backup Plate: Minimum 14-gauge steel strap punched for two anchors.
 3. Anchors: Self-tapping washer head screws, cadmium-plated, length and type recommended by manufacturer.
 4. Tie: Minimum 3/16-inch diameter steel wire, triangular shaped, embedded minimum 1-1/2 inch into veneer.
 5. Finish: ASTM A153, Class B-2, hot-dip galvanized with 1.5 ounces of zinc coating per foot.
 6. Acceptable Products:
 - a. Heckmann Building Products, Inc. "No. 213" and "No. 282" wall tie.
 - b. Hohmann & Barnard, Inc. "#HB-213-2x Adjustable Veneer Anchor".
 - c. Masonry Reinforcing Corporation of America, Wire Bond, "RJ-711" veneer anchor with "2401" plate and "2402" hook.
- B. Masonry Veneer Anchor System to Concrete Masonry Unit: Specified in Section 042200.
- C. Dovetail Anchoring; Masonry to Concrete Walls:
1. Slots: Standard 1-inch wide x 1-inch deep with 5/8-inch throat, minimum 24-gauge galvanized steel.
 - a. Heckmann Building Products, Inc. "100".
 - b. Hohmann & Barnard, Inc. "#305".
 - c. Masonry Reinforcing Corporation of America, Wire Bond, "1304".
 2. Anchors: 3-1/2-inch-long x 1/4-inch diameter hot dipped galvanized wire.
 - a. Heckmann Building Products, Inc. "No. 103".
 - b. Hohmann & Barnard, Inc. "#315-Flexible Dovetail Brick Tie".
 - c. Masonry Reinforcing Corporation of America, Wire Bond, "2102".
- D. Weep Cell Vents: Flexible ultra-violet resistant polypropylene co-polymer vent, 3/8-inch wide x 2-1/2 inches high x 3-3/8 inches long; color selected by Architect; perforated to prevent foreign matter entry from exterior.
1. Hohmann & Barnard, Inc. "QV-Quadro-Vent".
 2. Masonry Reinforcing Corporation of America, Wire Bond, "3601".
 3. Mortar Net Solutions "CellVent".
- E. Setting Bed: Type "S" as per ASTM C270 or portland cement mortar, specified in Section 040500.

- F. Weather/Air Barrier: As specified in Section 072720.
- G. Masonry Cleaning Compounds: As recommended, and tested by, selected brick manufacturer for each selected brick type and color.

2.3 FLASHING SYSTEMS

- A. Thru Wall Flashing Basis of Design Manufacturer and Type: Mortar Net Solutions, “Total Flash” unitized flashing and cavity drainage system.
 - 1. Other Acceptable Manufacturers as follows:
 - a. Advanced Building Products Inc.
 - b. York Manufacturing, Inc.
- B. Components:
 - 1. Flashing Membrane: EPDM membrane 0.045-inches, 18-inch.
 - 2. Termination Bar; Stainless Steel: 1.25-inch high x 16-gauge thick x 59-5/8-inch-long, 1/2-inch lip, predrilled holes 6-inch on-center.
 - 3. Drip Edge; Stainless Steel: 3-inch x 26 gauge, 3/8-inch hemmed edge or Kynar coated galvanized steel.
 - 4. Corner Boot: 14-inch high inside/outside corner boots of thermoplastic material.
 - 5. End Dams: Right, Left, Universal, thermoplastic material.
 - 6. Metal Drip Edge Corners: Pre-formed outside 90°, stainless steel or Kynar coated to match drip edge.
 - 7. Cavity Drainage Material: Mortar Net, USA, Ltd. “Wall Defender” strips, full-depth of cavity, 2-inch thick polyester mesh; 10-inches wide, with dovetail shaped notches 7-inches deep to prevent cavity form clogging with mortar drippings.
 - 8. Sealant: As recommended by Manufacturer.
- C. Sill Flashing:
 - 1. Basis-of-Design Manufacturer and Type: York Multi-Flash SS, stainless steel fabric flashing, 304 stainless steel in sizes to span cavity, ASTM E84.
 - 2. Other Acceptable Manufacturers and Products:
 - a. W.R. Grace, GCP Applied Technologies, “Perma Barrier”.
 - b. Holman & Barnard, Inc. “C-Fab”.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Ensure items built-in by other trades for this work are properly located and sized.
- B. Establish all lines, levels, and coursing. Protect from disturbance.
- C. Provide temporary bracing during erection of brick masonry work. Maintain in place until building structure provides permanent bracing.

3.2 ERECTION

- A. Lay brick masonry plumb, level and true to line with accurate coursing.
- B. Fully bond external and internal corners and intersections. Stop off horizontal run by racking back in each course; toothing is not permitted.

- C. Do not shift or tap brick masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
- D. Perform cutting on Project site with proper power tools to provide straight and true, unchipped edges. Units smaller than one-half are not permitted.
- E. Ensure brick masonry courses are of uniform height. Make vertical and horizontal joints equal and of uniform thickness.
- F. Mortar Beds: Lay brick masonry units in full face bed shelling, except lay bottom course in full mortar bed.
1. Lay brick in running bond pattern, unless indicated otherwise in Drawings.
 2. Butter head joints solid full width of brick before placing units.
 3. Fill joints without slushing.
 4. Rock closures into place with head joints thrown against two adjacent bricks in place.
 5. Do not pound corners or jambs to fit stretcher units after setting in place.
 6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.
 7. Remove excess mortar and projections. Take care to prevent breaking corners.
- G. Lay masonry units dry. During prolonged hot and dry periods, units may be lightly dampened if approved by Architect. For brick having more than .025 oz. per square inch per minute absorption, drench with water and allow to drain, and lay while damp.
1. Do not lay freshly wet masonry, or masonry bearing a film of ice or frost.
 2. Lay brick units with 3/8-inch thick bed and head joints to work to modular dimensions.
- H. Lay first course of brick above and below ledges, support angles, and caulk joints with 100% solid units and at all sills, caps and similar applications which would otherwise result in exposed brick cores, provide 100% solid units.
- I. Mortar Joints: Provide 3/8-inch nominal thickness mortar joint. Tool joints where exposed to view when "thumbprint" hard, to hard concave surface with 5/8-inch radius by 18-inch long steel jointing tool.
1. Trowel point or concave tool joints below grade.
 2. Flush cut joints where concealed by finish materials other than paint.
 3. As Work progresses, trowel protruding mortar fins in cavity flat to inner face of wythe.
- J. Weep Cells:
1. Do not let mortar fall into cavity air space or plug weep holes; clean out promptly.
 2. Install weep vents in veneer at 1'-4" on center horizontally at heads and sills of openings, in exterior walls at grade, and in other locations where flashing is indicated. Locate all weep cells above grade.
 3. Form weeps by placing cells in mortar joints, extending into cavity.
 4. Keep weep cell vents and area above flashing free of mortar droppings.
 5. Install cavity drainage material in cavity in compliance with manufacturer's recommendations.
- K. Acceptable Tolerances: As follows in compliance with Brick Institute of America (BIA) recommendations:
1. Maximum Variation from Plumb:
 - a. In Lines and Surfaces of Walls and Arises:
 - 1) 1/4-inch in 10'-0"
 - 2) 3/8-inch in any story or 20'-0" maximum.

- 3) 1/2-inch in 40'-0"
- b. For External Corners, Expansion Joints and Other Conspicuous Lines:
 - 1) 1/4-inch in any story or 20'-0"
 - 2) 3/8-inch in 40'-0"
2. Maximum Variation from Level or Grades for Exposed Lintels, Sills, Parapets, Horizontal Grooves, and Other Conspicuous Lines:
 - a. 1/4-inch in any bay or 20'
 - b. 1/2-inch in 40'-0" or more.
3. Maximum Variation of Linear Building Line from Established Position in Plan and Related Portions of Columns, Walls, and Partitions:
 - a. 1/2-inch in any bay or 20'-0"
 - b. 3/4-inch in 40'-0" or more.
4. Maximum Variation in Cross-Sectional Dimensions of Columns and Thickness of Walls: Not less than 1/4-inch smaller nor more than 1/2-inch larger than indicated.

3.3 ANCHORAGES

- A. Anchor single wythe masonry veneer to metal studs with masonry veneer anchors to comply with following requirements:
 1. Fasten each anchor section through sheathing to metal studs with two noncorrosive self-drilling, self-tapping, #10 diameter x length required to penetrate steel stud in compliance with ASTM C954.
 2. Embed tie section in masonry joints. Provide not less than 2-inches air space between back of masonry veneer wythe and face of sheathing.
 3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.
 4. Space anchors as indicated but not more than 16-inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals around perimeter not exceeding 36".
- B. Anchor masonry to structural members where masonry abuts or faces structural members to comply with following:
 1. Provide an open-air space minimum 2-inches in width between masonry and structural member, (including insulation) unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure. Weld column anchor 1'-4" o.c. on flange. Weld beam anchors 16" o.c.
 3. Anchor brick masonry to concrete masonry walls, with ladder type reinforcing specified in Section 042200 spaced not more than 16" apart.
- C. Reinforce exterior joint corners and intersections with 1/4-inch diameter metal rods 1'-4" on center.

3.4 JOINTS

- A. Sealant Joints: Retain 1/2-inch deep by 1/4-inch wide sealant joint around outside perimeter of exterior doors, window frames, and other wall openings.
- B. Expansion Joints:
 1. Provide continuous under shelf angles.
 2. Space vertical expansion joints as indicated in Drawings. Make vertical joints 3/8-inch wide and horizontal joints 1/4-inch wide.
 3. Install prefabricated joints with lengths butted.

4. Caulk joints in compliance with Section 079200.
5. Provide watertight joints, free from voids, after caulking.
6. Coordinate location of brick expansion joints with control joints in concrete unit masonry backup.

3.5 BUILT-IN ITEMS

- A. As work progresses, build-in hollow metal frames, access doors, steel angle lintels, anchors, sleeves, inserts, boxes, conduit, and other Work to be built into masonry.
 1. Tightly enclose sleeves for pipes, ducts and other items which pass through masonry.
 2. Verify anchorages embedded in concrete and attached to structural steel members are properly placed. Embed anchorages in every second joint.
- B. Hollow Metal Frames:
 1. Fill in hollow metal frames solid with grout as walls are constructed.
 2. Build-in anchors and enclose floor clips to secure tight, vibration-free frame.

3.6 MASONRY FLASHING INSTALLATION

- A. Extend flashings through veneer, turn up minimum 8-inches and secure to concrete masonry back-up and sheathing with termination bar. Run flashing onto sheathing back-up behind weather/air barrier. Adhere flashing to substrate minimum 1-1/2-inch width, continuous.
- B. Lap end joints minimum 6-inches and seal watertight.
- C. Use flashing manufacturer's recommended adhesive.

3.7 THRU WALL FLASHING INSTALLATION

- A. Install wall flashing at exterior door heads, window heads and other wall openings and at weep locations, continuous in the bed joint beneath the weeps.
- B. Extend flashing 8" beyond opening on each side. Lap joints 3" minimum and seal with adhesive.
- C. Install all-inclusive flashing system per manufacturer's instructions. Ensure Weep Tabs do not extend beyond face of masonry or brick veneer.
- D. Coordinate location of CMU joint reinforcing with top of flashing material.
- E. Repair or replace all flashing damaged during construction before covering up.

3.8 CLEANING

- A. Replacement: Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform appearance.
- C. Periodic Cleaning:

1. Clean exposed masonry surfaces as Work progresses as soon as practical after erection.
2. Exercise care to avoid splashing mortar onto masonry and other finished surfaces.
 - a. Remove loose mortar and fins with trowel and stiff fiber brushes.
 - b. Remove mortar droppings and splashed mortar immediately.
3. Thoroughly wash down walls with clean water and leave in proper condition for applied finishes.
4. Thoroughly clean exposed masonry surfaces of efflorescence, stains, discolorations, and other blemishes which will mar finished appearance of surfaces.

D. Final Cleaning:

1. Minimum 21 days prior to applying cleaning solution to brick masonry Work, apply solution to one-half of mock-up surface. Notify Architect immediately of all discoloration of brick or mortar joints, efflorescence, or staining. Do not proceed until further instructions from Architect.
2. No wet cleaning within seven days of placing masonry.
3. Saturate mortar joints with clean water and flush off loose debris minimum two hours prior to applying cleaning solution.
4. Begin cleaning process at highest point of wall, working downward. Work in areas of 20 sq. ft. maximum. Flush wall as cleaning progresses to prevent accumulation of scum.
5. Safely discard solutions containing debris and residue.
6. Do not scrub mortar joints with cleaning solution.
7. Protect materials adjacent to brick work subject to corrosion from contact with acid solution.
8. Apply manufactured cleaning compound on brick masonry as tested on mockup in compliance with manufacturer's product data. Flush with clean water.
9. Remove stains in compliance with recommendations of Brick Institute of America, Technical Notes #20, Revised 11/1990. Use cleaning agents only after pretesting on mockup.

3.9 PROTECTION

- A. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane.
 1. Extend membrane at least 24" down both sides of wall and anchor securely in place.
- B. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Protect clean surfaces from future soiling and reclean as necessary to leave completed Work in first-class condition.
- D. Protect sills, ledges, and offsets from mortar droppings during construction.

END OF SECTION

SECTION 080527 - SECURITY FASTENERS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Tamper proof security screws, bolts, and nuts.
- B. Related Sections:
 - 1. 083100 – Access Panels
 - 2. 087100 – Door Hardware
 - 3. 102800 – Toilet Accessories

1.02 REFERENCES

- A. American Architectural Manufacturers Association (AAMA)
- B. American Society for Testing and Materials (ASTM)
- C. Aluminum Association (AA)

1.03 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
- B. Design Requirements: Configured to restrict the use of Torx-Pin, Hex-Pin and all other tamper-resistant bits. Bits are controlled through the manufacturers customer database.
- C. Performance Requirements:
 - 1. Hardware pieces to meet a minimum Level 6 Security Level

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility:
 - 1. Obtain Security Screens, entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.

1.05 WARRANTY

- A. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of twenty-five (25) years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Bryce Manufacturing Security Fasteners
- B. Acceptable Products:
 - 1. “Penta Plus” Security Fastener System or equal.
 - 2. Substitutions MUST be approved by the Architect AND the Owner.

2.02 MATERIALS AND ACCESSORIES

- A. Hardware members: sloped, low-profile button head shape to restrict the use of tampering tools. Hardware shall meet or exceed all IFI specifications.
- B. Screws, fastening devices, and internal components: zinc-plated steel in accordance with ASTM.A-164. Anchors shall be steel,
- C. Hardware shall include “Raptor-claw” (or Approved Equal) serrations on the underside of the head designed to cut and dig into the metal substructure surface, effectively creating a “lock”.

2.03 FINISH

- A. Finish all exposed areas of aluminum and components as indicated.
 - 1. An Architectural Class II and I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic #11 Clear or match the manufacturers standard finish.

2.04 SYSTEM FABRICATION

- A. The perforated panel shall be attached between the main frame and interlocking cover plate with tamper resistant screws 3 inches on center maximum
- B. There shall be no exposed fasteners at perimeter sections.

PART 3 – EXECUTION

3.01 Examinations

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 Installation

- A. Install in accordance with approved shop drawings and manufacturers installation instructions.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

11 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Downspout boots.
- C. Cast iron trench castings.

12 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 055133 - Metal Ladders.
- C. Section 055213 - Pipe and Tube Railings.
- D. Section 099113 - Exterior Painting: Paint finish.
- E. Section 099123 - Interior Painting: Paint finish.

13 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - A36/A36M Carbon Structural Steel.
 - A53/A53M Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - A123/A123M Zinc Hot-Dip Galvanized Coatings on Iron and Steel Products.
 - A153 Zinc Coating Hot-Dip on Iron and Steel Hardware.
 - A307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - A325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - A563 Carbon and Alloy Steel Nuts.
 - A1008 Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - E894 Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - E935 Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- B. American Welding Society (AWS):
 - A5.1 Covered Carbon Steel Arc Welding Electrodes.
 - D1.1 Structural Welding Code for Steel.

14 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Specifications, installation instructions, details and finish selection charts for manufactured products.
- C. Shop Drawings: Fabrication and installation plans, elevations, details and sections.

1. Indicate profiles, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories.
 2. Indicate individual items, member sizes, metal thicknesses and gauges, and finishes.
 3. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
- D. Calculations: For installed products indicated to comply with design loads, include structural computations, materials properties, and other information needed for structural analysis, signed and sealed by qualified professional engineer licensed in State of Georgia.
- E. Product Tests Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.
- F. Test railings according ASTM E894 and ASTM E935.
- G. Letter of Conformance: In compliance with requirements of, and in format included in, Section 01 3300.
- 12 QUALITY ASSURANCE
- A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

- 21 MATERIALS - STEEL
- A. Anchoring Cement: Exterior erosion-resistant anchoring cement.
1. Adhesives Technology "Hard-Rok".
 2. Master Builders Solutions, a Sika Company, "MasterFlow 110 AN".
 3. ProSpec "High Strength Precision Grout".
 4. Five Star Products, Inc., "Five Star Grout."
- B. Electrodes: AWS A5.1, low hydrogen arc-welding electrodes, E70XX.
- C. Fasteners: Provide anchors, bolts, expansion devices, and miscellaneous accessory items necessary for complete and finished installation. Provide fasteners exposed to exterior with zinc coating in compliance with ASTM A153.
1. Bolts: ASTM A307.
 2. Concrete Wedge Anchors: Wedge anchors, expansion bolts, or similar anchors, with maximum 2400 lb. pull-out for 1/4-inch machine bolts.
 3. Nuts: ASTM A563, grade suitable for bolts.
 4. Gypsum Board: Flat head spring toggle bolts, sheet metal screws or hollow wall anchors.
 5. Hanger Rods:
 - a. Material: ASTM A36.
 - b. Threads: ASTM A307.
 6. Wood: Lug Bolts; ASME B18.2.1.
- D. Galvanize Touch Up Paint: Brush apply only in two coats.
1. PPG Industries, "Aguapon Zinc Rich Primer"
 2. Sherwin-Williams "Zinc-Clad 5 Organic B69A45".
 3. ZRC Worldwide "Z.R.C. Cold Galvanizing Compound".

- E. Grating: Galvanized after fabrication and furnished with 4 bent clips for each panel.
 - 1. Elevator Sump Pit Grating: IKG/Borden "Borden Grating Type F", rectangular pressure locked steel grating, size 6, made with 1-1/4 inch x 3/16-inch bearing bars at 1-3/16 inch centers and 3/4-inch x 1/8-inch cross bars at 2-inch centers. Capable of withstanding minimum 100 pounds per square foot.
 - 2. Other Acceptable Manufacturers: Subject to compliance with all requirements of this specification, provide named products and systems or comparable products and systems by one of following manufacturers:
 - a. McNichols Co.
 - b. Seidel Huber Metal Products.
- F. Shop Primer Paint:
 - 1. Compatible with required finish coats of paint. Coordinate selection of metal primer with finish paint specified in Section 09 90 00.
 - 2. Apply shop primer to uncoated surfaces of metal fabrications, those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated.
- G. Steel: ASTM A36, unless noted otherwise.
 - 1. Wide Flanges and Channels: American Standard rolled sections.
 - 2. Tees: Cut from American Standard beams.
 - 3. Angles: Equal and unequal leg rolled sections.
 - 4. Plates and Bars: Flat rolled universal mill or sheared plate.
- H. Steel Pipe: ASTM A53, Type F or Type S, Grade B, Schedule 40, continuously welded, ground and filed smooth, buffed out with all pipe scale removed with black finish.
 - 1. Diameter and profiles refer to Pipe Schedule as indicated on Drawings.

22 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

23 FABRICATED ITEMS

- A. This schedule is a list of principal items, but not limited to. Complete assembly with anchoring and attachments as required for proper installation. Refer to drawings for items not specifically scheduled.
 - 1. Ledge and shelf angles, channels and plates not attached to structural steel for support of metal decking and steel joists.

2. Pipe handrails, barriers, concrete filled steel pipe bollards, and sleeves cast into concrete.
 3. Miscellaneous angles, clip angles and braces; galvanized finish for all exterior locations
 4. Pipe handrails, barriers, concrete filled steel pipe bollards, and sleeves cast into concrete.
 5. Framing, bracing and supports for overhead coiling doors.
 6. Miscellaneous angles, clip angles and braces; galvanized finish for all exterior locations.
 7. Framing supporting louvers.
 8. Expansion joint covers; angles; plates.
 9. Curb angles and concrete anchors at roof and floor deck openings; loading dock; and elsewhere as indicated in Drawings.
 10. Channel struts and angle bracing for ceiling hung toilet compartments.
 11. Miscellaneous angles, plates and bolts for support and connection of curtain wall framing and window wall framing.
 12. Bracing and supports for ornamental metal.
 13. Stair nosings; thresholds; sills.
 14. Bumper posts and guardrails; prime paint finish and field painted in compliance with Section 09 9000 at interior locations; hot-dip galvanized, primed and field painted in compliance with Section 09 9000 at exterior locations.
- B. Grating, i. e., elevator sump pit grates; not supported by structural steel.
- C. Steel channel, angle frames and lintels for openings in masonry; shelf and relief angles in brick masonry; galvanized finish. .
- D. Miscellaneous studs for ceiling support system.
- E. Ladders.
- 25 FINISHES - STEEL
- A. Prime paint steel items.
 1. Exceptions: Stainless steel items.
 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
 - B. Prepare surfaces to be primed in accordance with SSPC-SP2.
 - C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 - D. Prime Painting: One coat.
 - E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- 26 FABRICATION TOLERANCES
- A. Squareness: 1/8-inch maximum difference in diagonal measurements.
 - B. Maximum Offset Between Faces: 1/16 inch.
 - C. Maximum Misalignment of Adjacent Members: 1/16 inch.
 - D. Maximum Bow: 1/8 inch in 48 inches.
 - E. Maximum Deviation from Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

32 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

34 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or adjusting not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- G. Corner guards and bollards:
 - 1. Install corner guards at exterior corners in parking deck locations indicated
 - 2. Install steel corner guards and bollards at locations shown.
- H. Headache bar: Install as indicated on drawings.

35 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

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SECTION 061000 – ROUGH CARPENTRY

PART 1 GENERAL

1.1 DESCRIPTION

- A. Related work specified elsewhere:
 - 1. Concrete formwork.
 - 2. Finish carpentry and millwork.
 - 3. Gypsum wallboard systems.
 - 4. Painting.

1.2 REFERENCE STANDARDS

- A. National Green Building Standard ICC 700

1.3 SUBMITTALS

- A. Preservative treated wood certification: Submit for information only. Submit certification by treating plant stating chemicals and process used, net amount of salts retained, and conformance with applicable standards.
- B. National Green Standard ICC 700 Submittals: Submit manufacturer's data indicating compliance with Chapter 6: Resource Efficiency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to job site, place materials in areas protected from weather.
- B. Store materials a minimum of 6" above ground on blocking and cover with protected waterproof covering, providing for adequate air circulation and ventilation.
- C. Do not store seasoned materials in wet or damp portions of building.
- D. Protect sheet materials from breaking corners and damaging surfaces.

1.5 QUALITY CRITERIA

- A. Applicable Standards: Grading rules and standards of the following associations apply to materials furnished under this section:
 - 1. Southern Pine Inspection Bureau (SPIB).
 - 2. National Forest Products Association (NFPA).
 - 3. West Coast Lumber Inspection Bureau (WCLB).
 - 4. Western Wood Products Association (WWPA).
 - 5. American Society for Testing and Materials (ASTM) as referenced.
- B. Plywood Grading Rules: Softwood plywood, Construction and Industrial; Product Standard PS-1-74.
- C. Grade Marks: Identify all lumber and plywood by official grade marks.
 - 1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable, and condition of seasoning at time of manufacture.
 - 2. Softwood Plywood: Appropriate grade trademark of the American Plywood Association indicating:
 - a. Type, grade, class, and identification index.
 - b. Inspection and testing agency mark.
- D. Preservative Treated Material: Meeting specified standards of the American Wood Preservers Association (AWPA) and American Wood Preservers Institute (AWPI) as indicated.

1.5 COORDINATION

- A. Coordinate the Work of this Section with other interfacing work in direct contact with the products listed herein. Consult with manufacturer for compatibility of materials specified in other sections that will be in contact with the products listed in this Section.

PART 2 PRODUCTS

2.1 LUMBER

- A. Dimensions: Indicated lumber dimensions are nominal. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and all the rules writing agencies.
- B. Moisture Content: 19% maximum at time of permanent closing in of building or structure, except as otherwise noted.
- C. Surfacing: Surface four sides (S4S).
- D. Framing Lumber:
 - 1. Main framing:
 - a. Beams and headers: #2 Southern Pine
 - 2. Light framing:
 - a. General framing: #2 Spruce-Pine-Fir.
 - b. Plates, blocking, bracing, and nailers: #3 Spruce-Pine-Fir. Lumber in contact with concrete slabs, exterior masonry walls, or in conjunction with gravel stops or roofing shall be preservative treated in accord with AWPA C1-77 and AWPI LP-22, CCA, Type A, non-leaching type preservative.
 - c. General utility purposes: Utility Grade or #3 Spruce-Pine-Fir.
 - 3. Studs:
 - a. Loadbearing and Exterior: #2 Spruce-Pine-Fir.
 - b. Non-loadbearing: Stud grade Spruce-Pine-Fir.
 - 4. Structural joist and planks: 2" to 4" thickness, 6" and wider: #2 Spruce-Pine-Fir or Western Lumber, except where spans exceed allowable as defined by National Forest Products Association, "Span Tables for Joist and Rafters", shall be as required by span. Maximum moisture content: 19%.
 - 5. Plates:
 - a. Wall Top and Bottom Plates: #3 Southern Pine

2.2 SHEET MATERIAL

- A. Plywood:
 - 1. Miscellaneous: APA Rated sheathing, EXP-1, Group I, tongue and groove edges, thickness indicated.

2.3 PRESERVATIVE TREATED MATERIALS

- A. Standards:
 - 1. Lumber: Meeting AWPA C-1,
 - 2. Sheet: Meeting AWPA C-9.

2.4 HARDWARE

- A. Provide nails, bolts, nuts, washers, screws, expansion bolts, clips, powder actuated fasteners and similar hardware necessary for complete installation of rough carpentry items. Provide G90 hot-dipped galvanized steel or Type 304 stainless steel for components for all non- pressure treated and fire-retardant treated lumber except nails shall be hot-dipped galvanized. Material and finish for use with pressure preservative treated components shall be G185 hot- dipped galvanized steel or Type 316L stainless steel.

PART 3 EXECUTION**1.1 WORKMANSHIP**

- A. Install wood framing and carpentry work cut square on bearings, closely fitted, accurately set to required lines and levels, and secured in place.
- B. Lay out the work to provide correct openings to receive work of other trades.
- C. Brush apply preservative treatment to cut ends of treated lumber. Materials shall be of same types as used for original treatment.

1.2 STUD FRAMING

- A. Plates and stud members:
 - 1. Provide single bottom plate and double top plates for partitions.
 - 2. Provide studs in continuous lengths without splices.
 - 3. Toenail studs to bottom plate and end-nail to lower top plate. Provide Hurricane straps as shown on drawing.
 - 4. Overlap double top plate minimum of 6" at corners and intersections.
 - 5. Face nail upper top plate to lower top plate and provide hurricane straps as shown on drawing.
 - 6. Nail bottom plate to wood construction and provide hurricane straps as shown on drawing.
 - 7. Nail bottom plate to wood construction and provide hurricane straps as shown on drawing.
 - 8. Triple studs at corners and partition intersection.
 - 9. For partition parallel with joist: Locate joist directly below studs.
 - 10. Framing openings:
 - a. Double studs and headers: Opening less than 4'-0", unless noted otherwise on drawings.
 - b. Triple studs and headers: Openings 4'-0" and greater, unless noted otherwise on drawings.
 - 11. Space studs at 1'-4" o.c. maximum, unless noted otherwise on drawings.
 - B. Headers:
 - 1. Provide continuous headers, same width as studs, depth required to span opening.
 - 2. Toenail headers to studs and opening framing.
 - 3. Lap headers at intersection with bearing partitions or tie with metal straps.
 - C. Blocking:
 - 1. Install in continuous horizontal row in middle 1/3 of stud height and at all horizontal plywood joints.
 - 2. Wedge, align and anchor blocking with nails.
 - 3. Coordinate blocking with locations of finishing materials, fixtures, specialty items and trim.
 - 4. Wood Sheathing Joints: Verify that all exterior wood sheathing joints, both horizontal and vertical, have blocking behind joints and that sheathing is continuously fastened to the blocking for the entire perimeter of the sheathing panels.
- 1.3 JOIST FRAMING**
- A. Install with crown edge up.
 - B. Support ends of each member minimum of 1-1/2" of bearing on wood or steel.
 - C. Lap members framing from opening sides of beams, girders or partitions minimum 4" or tie opposing members together by toe-nailing or metal connectors.
 - D. Notches:

1. Do not notch in middle third of joist.
1. Notches in top or bottom of joist: maximum of 1/6 depth of member.
2. Notched ends: Maximum 1/3 depth of member.
- B. Bored Nails: Maximum 1/3 depth of member, 2" minimum distance to top or bottom of joist.
- C. Solid Bridging:
 1. Size: 2" by depth of joist by length required.
 2. Offset bridging to permit end-nailing.
 3. Provide one row of blocking for spans up to 10'-0", two rows for spans over 10'-0".

1.2 RAFTER FRAMING

- A. Cut rafters to set on exterior wall plates. Shim and toenail to plate.
- B. At ridge, place rafters directly opposite each other and nail to ridge member. Provide bridging at third points.

1.3 SHEET MATERIAL INSTALLATION

- A. Plywood roof deck and subfloor: Install with face grain perpendicular to supports. Terminate panels over supports. Stagger end joints of adjacent panels.
 1. Allow 1/8" between end joints and 1/4" between edge joints for expansion and contraction.
 2. Attach plywood as shown on drawings.
 3. Provide sheathing clips at mid-span of roof sheathing.

END OF SECTION

SECTION 062023 – INTERIOR FINISH CARPENTRY**PART 1 GENERAL****11 SUMMARY****A. SECTION INCLUDES**

1. Finish carpentry items.
2. Plastic Laminates
3. Solid Surfaces

12 RELATED SECTIONS

- A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 081416 - Flush Wood Doors.
- D. Section 099113 - Exterior Painting: Painting of finish carpentry items.
- E. Section 099123 - Interior Painting: Painting of finish carpentry items.
- F. Section 099300 - Staining and Transparent Finishing: Staining and transparent finishing of finish carpentry items.

13 REFERENCE STANDARDS

American National Standards Institute (ANSI):

A208.1 Particleboard, Mat-Formed Wood.

American Plywood Association (APA):

PRP-108 Performance Standards and Policies for Structural-Use Panels, Form No. E445M, May 1991 Edition.

E30K ADA Design/Construction Guide - Residential & Commercial.

Architectural Woodwork Standards (AWS):

Architectural Woodwork Standards, Edition 1.

National Electrical Manufacturers Association (NEMA):

LD-3 High Pressure Decorative Laminates.

National Institute of Standards and Technology (NIST):

PS 1 U.S. Product Standard for Construction and Industrial Plywood.

PS 20 American Softwood Lumber Standards.

West Coast Lumber Inspection Bureau (WCLB):

Standard Grading Rules No. 17.

Western Wood Products Association (WWPA):

Western Lumber Grading Rules

14 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

15 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data:
 - 1. Provide data on fire retardant treatment materials and application instructions.
 - a. Exception: Not required if no fire retardant material is used in the project.
- C. Shop Drawings: Detailed shop fabrication and installation drawings to Architect for review.
 - 1. Indicate wood species, materials, component profiles, joinery, hardware, finishes, accessories, connections, and relationship to adjacent Work.
 - 2. Properly note all fixed dimensions and variable dimensions as applicable.
 - 3. Indicate joints in exposed plastic laminate.
- D. Letter of Conformance: In compliance with requirements of, and in format included in, Section 01 33 00.

16 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: Employ tradesmen experienced in fabrication and installation of finish carpentry to ensure strict compliance with approved design and approved recommendations of materials manufacturers.
- B. Perform finish carpentry work in compliance with recommendations of Millwork Sections of Architectural Woodwork Institute.
- C. Material Grade for Interior Woodwork: AWS "Custom Grade" as defined in following Sections of Quality Standards:
 - 1. Lumber Grades: Section 3.
 - 2. Plywood and Particleboard Grades: Section 4.
 - 3. Standing and Running Trim: Section 6.
 - 4. Casework: Section 10.
 - 5. Closet and Storage Shelving: Section 6.
 - 6. Countertops: Section 11.
 - 7. Paneling: Section 4.

12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- C. Protect from moisture damage.
- D. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

21 FINISH CARPENTRY ITEMS

- A. Quality Grading and species in compliance with PS 20 and SPIB, or other agency having jurisdiction.
- B. Framing Lumber: No. 2 Dimension, Southern Pine.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Moisture Content and Wood Treatment: Specified in Section 06 10 00.
- C. Interior Woodwork for Stained Veneer Finish:
 - 1. Face Veneers: "Grade A", "White Birch", rotary cut, stain finish.
 - 2. Plywood: "Grade I", "White Birch" solid stock.
- D. Interior Woodwork for Paint Finish:

1. Wood Species: "Grade I" Poplar, Ponderosa Pine, clear Maple or Birch.
2. Plywood: "Custom Grade" Natural Birch.
- E. Solid Backing to Receive Wood Veneer Finish:
 1. Up to 8-Inches Wide: Straight "Premium Grade" Poplar or Birch free of knots, warp, or twist.
 2. Over 8-Inches Wide: ANSI A208.2, medium density fiberboard (MDF), 40 to 50 pounds per cubic foot, 5,000 psi modulus of rupture, 450,000 psi average modulus of elasticity.
 3. Fire Rated: Masonite Corporation "X-Flame" or Willamette Industries, Inc. "Duraflake FR" fire-retardant particle board.
- 22 LUMBER SUBSTRATES
 - A. Particleboard: ANSI 208.1, high density particleboard for shop applied plastic laminate substrate.
- 23 PLASTIC LAMINATES
 - A. Surfaces; Countertops and Backsplashes Decorative Laminate; Basis-of-Design Manufacturer and Type: Wilsonart International; Div. of Premark International, Inc., solid color high pressure decorative laminate sheets conforming to following grades and thicknesses in compliance with NEMA LD-3.
 1. Surfaces:
 - a. Horizontal Wearing Surfaces: "HGS"; minimum 0.050-inch thick for shelves, countertop, splash, and apron face.
 - b. Vertical Exposed Surfaces: "VGS"; minimum 0.030-inch thick.
 - c. Edge Banding: 0.5 mm PVC to match face laminate.
 - d. Concealed Surfaces: "BKL"; minimum 0.020-inch thick backing sheet.
 - e. Semi-Exposed Surfaces (In View When Door and Drawers Open): "CLS"; minimum 0.020-inch thick in solid color selected by Architect.
 - f. Post-Forming: "HGP"; nominal 0.039-inch thick.
 - g. Backer: "BKL"; nominal 0.020-inch or thicker. Used on back of substrate to balance materials.
 2. Adhesive: As recommended by high pressure decorative laminate manufacturer for application to wood or particleboard.
 3. Colors: Refer to List of Finishes on Drawings for color selections and installation locations.
 - B. Other Acceptable Manufacturers:
 1. Formica Corporation.
 2. Nevamar Corporation.
 3. Panolam Surface Systems Pionite.
- 24 HIGH PRESSURE LAMINATE
 - A. Solid Phenolic Wall Panels: Basis of Design - Trespa "Meteon" by Trespa International
 - B. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.

C. Structural Performance (ASTM E330):

1. Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot (psf). Wind load testing shall be done in accordance with this standard to obtain the following results:
 - a. Normal to the plane of the wall, the maximum panel deflection shall not exceed $L/175$
 - b. Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed
2. $L/175$ or 3/4 inch, whichever is less
 - a. At 1-1/2 times design pressure, permanent deflection of framing members shall not exceed $L/100$ of span length and components shall not experience failure or gross permanent distortion.
 - b. If system tests are not available, mockups shall be constructed and tests performed under the direction of an independent third-party laboratory which show compliance to the minimum standards listed above.

D. Fire Performance:

1. Flame Spread: Class A, ASTM E 84.
2. Smoke Development: Less than 450, ASTM E 84.
3. Ignition Temperature: Greater than 650 degree F (350 degree C) above ambient, ASTM D1929.
4. Burning Classification: CC1 or CC2, ASTM D635.
5. When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire-Resistant Assemblies, ASTM E119.
6. When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.
7. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.

E. Finish Performance: In conformance with the following general requirements:

1. Color: As selected by the architect/engineer from manufacturer's standard colors or a custom color to be matched by the panel supplier.
2. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree F (38 degree C) for 3000 hours, ASTM D 2247.
3. Salt Spray Resistance: Corrosion creepage from scribe line (1/16 inch (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.
4. Weather Exposure: Accelerated - 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change

of 5 Delta E units from the original color according to ASTM D-2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according to ASTM D-2244.

5. Color Stability: The decorative surface complies with, classification, 4 - 5 measured with the grey scale according to ISO 105 A02-93 according to test method EN 438-2:29.
 6. Microbial Characteristics: Will not support micro-organic growth (ISO 846).
- F. Mounting System:
1. TS210 - Concealed fastening over fixed depth aluminum sub-framing.
 2. Other installation systems - Include test documentation showing compliance with the performance criteria set forth in the specification and in accordance with the local building code.
 3. Aluminum Sub Structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.
 4. Extrusions, including corner closures, joint closures, and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.
- G. Extruded Aluminum Trim: Color as specified in the finish schedule.

25 SOLID SURFACES

- A. SS-1; Solid Surfacing Window Sills and Serving Line: DuPont Polymers "Corian" homogeneous solid sheets of filled plastic resin complying with material and performance requirements of ANSI Z124.3, Type 5 or Type 6, without precoat finish; 1/2-inch thick. Refer to Finish Legend on Drawings for color selection.
- B. Other Acceptable Manufacturers:
 1. Formica Corp. "Surell".
 2. Nevamar Corp. "Fountainhead".
 3. Wilsonart International; Div. of Premark International, Inc. "Gibraltar".
 4. Avonite Surfaces "Foundations".

26 FASTENERS:

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners: Of size and type to suit application; galvanized finish in concealed locations and stainless-steel finish in exposed locations.
- C. Fasteners: Of size and type to suit application; finish in exposed locations to match adjacent material finish unless detailed otherwise on drawings.
- D. Concealed Joint Fasteners: Threaded steel.

27 ACCESSORIES

- A. Primer: Alkyd primer sealer.
- B. Wood Filler: Solvent base, tinted to match surface finish color.

28 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Provide identification on fire retardant treated material.
- C. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

29 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

210 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
- E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

32 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

33 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 099123.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 061053 - Rough Carpentry: Support framing, grounds, and concealed blocking.
2. Section 062023 - Finish Carpentry: Plastic Laminate Materials
3. Section 099123 - Interior Painting: Field finishing of cabinet interior.
4. Section 123600 - Countertops.

1.2 REFERENCE STANDARDS

1. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0 2021.
2. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
3. UL (DIR) - Online Certifications Directory Current Edition.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 "Door Hardware" to manufacturer of architectural cabinets; coordinate Shop Drawings and fabrication with hardware requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. See Section 01 3000 - Administrative Requirements for submittal procedures.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 3. Include certification program label.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.
 1. To be reviewed separately by Owner and Interior Designer at jobsite.

- E. Samples: Submit actual sample items of proposed pulls and hinges, demonstrating hardware design, quality, and finish.
 - 1. To be reviewed separately by Owner and Interior Designer at jobsite.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Manufacturer of products.

1.7 MOCK UP: CABINETRY

- A. Erect a full size mock-up of architectural wood work at project site for Architect's acceptance. If unacceptable, erect additional mock-ups until acceptable.
- B. Mock-up shall indicate the following:
 - 1. Workmanship.
 - 2. Finishes.
 - 3. Relationships to adjacent work.
- C. Do not begin woodwork production until each mock-up has been accepted by Architect.
- D. See Section 01 4000 - Quality Requirements for additional requirements.
- E. Locate where directed.
- F. Accepted, undamaged, mock-ups may remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and

maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

- B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.2 PLASTIC LAMINATES (PL1 through PL4)

- A. Surfaces; Countertops and Backsplashes Decorative Laminate; Basis-of-Design Manufacturer and Type: Formica Inc., solid color high pressure decorative laminate sheets conforming to following grades and thicknesses in compliance with NEMA LD-3.
 - 1. Surfaces:
 - a. Horizontal Wearing Surfaces: "HGS"; minimum 0.050-inch thick for shelves, countertop, splash and apron face.
 - b. Vertical Exposed Surfaces: "VGS"; minimum 0.030-inch thick.
 - c. Edge Banding: 0.5 mm PVC to match face laminate.
 - d. Concealed Surfaces: "BKL"; minimum 0.020-inch thick backing sheet.
 - e. Semi-Exposed Surfaces (In View When Door and Drawers Open): "CLS"; minimum 0.020-inch thick in solid color selected by Architect.
 - f. Post-Forming: "HGP"; nominal 0.039-inch thick.
 - g. Backer: "BKL"; nominal 0.020-inch or thicker. Used on back of substrate to balance materials.

2. Adhesive: As recommended by high pressure decorative laminate manufacturer for application to wood or particleboard.
3. Colors: Refer to List of Finishes on Drawings for color selections and installation locations.

B. Other Acceptable Manufacturers:

1. Wilsonart Corporation.
2. Nevamar Corporation.
3. Panolam Surface Systems Pionite.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of architectural cabinets.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less in accordance with ASTM E84.

1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.

D. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less in accordance with ASTM E84.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Finish: All cabinet hardware shall be Brushed (Satin) Nickel; BHMA 619 (US 15), unless otherwise noted.
- C. Adjustable Shelf Standards and Supports: K & V "No. 255NP" Standards with "No. 256NP" or equal by Epcos or Blum. Supports to match or equal by Epcos or Blum; nickel plated finish.
- D. Hinges:
1. Blum 71M2550 x 175L6600.22.
 2. Grass 1006 x G/FFAL 2.6.
 3. Lamp 430-C46/19 x 430P4A32.
- E. Drawer Guides: Blum Standard 230M or equal by Epcos or Stanley, epoxy coated, bottom mounted, minimum load rating as listed:
1. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
 3. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
 4. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
 5. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
 6. Computer keyboard tray, provide 75 lb load capacity.
- F. Drawer Pulls: Stanley Works "No. 4484" or equal by Epcos or Blum, US26D, 5/16-inch diameter wire pull, 4-inch centers.
- G. Catches and Locks:
1. Magnetic Catch: K & V "No. 918 ALUM" or equal by Epcos or Stanley.
 2. Lock: K & V "No. 986"; nickel plated finish or equal by Epcos or Stanley.
- H. Cushion Stop: Rubber pad with leg for insertion in drilled hole or attached to metal mounting bracket. Provide at top and bottom of each cabinet door.
- I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Color: Black.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Color: As indicated on Architect's Finish Legend.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Rough Hardware: Nails, spikes, screws, bolts, anchors, washers and other rough hardware necessary to assure proper assembly and anchorage.
 - 1. Finish: Galvanized finish for exterior and interior work exposed to moisture and high humidity and brite basic (uncoated) finish for interior work not exposed to moisture and high humidity.
- C. One-Part Mildew-Resistant Silicone Sealant: One-part silicone rubber; mildew and stain resistant; color selected by Architect.
 - 1. Dow Corning Corp. "786 Mildew-Resistant Silicone Sealant".
 - 2. General Electric Co. "SCS 1702 Silicone Sanitary Sealant".
 - 3. Tremco, Inc. "Tremsil 600".
- D. Metal Brackets: Richelieu, "Model No. 9910242930" heavy duty bracket with 1,000 lb. load capacity @ 3'-0" o.c., white color.
- E. Adhesive for Bonding Plastic Laminate: Contact cement.

2.6 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
- C. Plastic Laminate Countertops and Panels and Casework:
 - 1. Apply plastic laminate finish in full uninterrupted sheets; hairline corners and joints.
 - 2. Locate counter butt joints at least 2 feet from sink cutouts.
 - 3. Fasten splash to countertop 16-inches on center.
 - 4. Make cutouts for lavatories, plumbing fixtures, and toilet accessories using either templates or physical samples of items to be used.
- D. Shop - cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 PROJECT CONDITIONS

- A. Field measurements: Take field measurements to ascertain exact woodwork sizes. Indicate exact dimensions on shop drawings.
- B. Install no interior woodwork until spaces are enclosed, dry and conditioned.
- C. Maintain temperature between 55 degrees F. and 80 degrees F. for 72 hours before beginning installation and afterwards until Date of Substantial Completion.
- D. Maintain interior relative humidity at the site between 25% and 55% before, during, and after installation.

3.3 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
 - 4. Install shelving and hanger rods level and plumb.
 - 5. Provide locks on all drawers and doors in all rooms.
 - 6. Plastic Laminate Countertops: All countertops shall receive a 4-inch high, plastic laminate backsplash at all adjacent walls. All sinks within the countertops shall be located at centerline to the length of the cabinet unless specified otherwise by Owner. Ends of countertops at adjacent walls shall receive backsplash end caps that are set in full bed of sealant between top and splash.
 - 7. On all casework, provide sealant as required to fill all cracks and voids between walls and finished casework/backsplash.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

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SECTION 072170 – RETROFIT INSULATION SYSTEM**PART 1 GENERAL****1.1 SUMMARY****A. SECTION INCLUDES**

1. Interior liner system fabric of the color specified, support strapping of the appropriate color, fasteners of the appropriate type and color, sealants, thermal break materials and thermal insulation of the appropriate type to insulate the roof areas to the full designed R-value of the building as specified.

1.2 RELATED REQUIREMENTS

- A. Section 07 2700 - Air Barriers: Separate air barrier materials.
- B. Section 07 2126 - Blown Insulation: Roof/ceiling assembly insulation.
- C. 07 2129 - Sprayed Insulation: Insulation applied to underside of structure.
- D. Section 07 2500 - Weather Barriers: Air barrier membrane where indicated on drawings.
- E. Section 09 2116 - Gypsum Board Assemblies: Exterior gypsum sheathing substrate for board insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.
- B. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation 2021a.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2021.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- J. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.
- K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Certificate: Certificate stating that installed products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Materials shall be inspected for damage, proper sizes and quantities upon delivery and stored in a dry, secure manner.
 - B. Installation shall proceed with care to assure proper sealing of the liner system fabric. Insulation shall be placed on the liner system fabric in the full-specified thickness without voids.
 - C. Substitutions of systems that do not have a continuous vapor retarder on the inside plane of the purlins or girts will not be allowed. Purlins, girts and insulation must be completely isolated from the inside conditioned air with an effective vapor retarder.
 - D. Taping or stapling of vapor retarder lap joints is not acceptable. Sealing field joints with a permanent vapor retarder lap sealant is required. Field seams, if any, shall be made on a structural member and mechanically attached with a steel strap and fasteners along its full length.
 - E. All exposed parts of the liner system shall be Class A material and have flame spread of 25 or less based on ASTM E84 standards. Vapor retarder fabric shall be white or colored woven coated fabric and triple extrusion-welded seams fabricated in one piece, to fit not less than the full bay length by the width of the building. Buildings more than 100' wide may have field seams on the bottom of a purlin but no less than 50' apart. Any field seams must be sealed with vapor retarder lap sealant. Wall bay minimum fabric size shall be not less than one entire wall bay or end wall column space from the ceiling to the floor. Perimeter edges of the vapor retarder fabric shall be trimmed and sealed to the adjoining steel or fabric with vapor retarder lap sealant. All edges of liner system fabric, including field seams, shall be mechanically fastened with steel retaining straps the full perimeter. In the event that the crew is not experienced in the installation procedures, video taped or on-site installation training shall be requested by the installing contractor from Thermal Design to assure proper installation procedures.
- 16 EMISSIONS
- A. Emissions shall be in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation.
 - B. Insulation shall be certified by a third-party program accredited to ISO 17065, such as, but not limited to, UL GREENGUARD Gold Scientific Certifications Systems (GSCS) Indoor Advantage Gold Program.
- 17 FIELD CONDITIONS
- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

21 GENERAL

- A. All installed thermal insulation shall meet the minimum requirements of the prevailing Energy Code.

22 MANUFACTURERS

- A. Roof Liner System: Basis Of Design - Acceptable system shall be the Simple Saver insulation system manufactured by Thermal Design with an installed total roof insulation R-value indicated by the Drawings and an average installed thickness as detailed.

23 MATERIALS

- A. Roof system shall be a single-layer system. A thermal break shall be applied where there is no existing thermal break between metal panel and metal structure. The thermal break shall be

3/16" x 3" Quik-Stop Trash Free foam tape.

1. Insulation Where indicated on Drawings: Extruded polystyrene (XPS) board.
 2. Insulation Inside Masonry Cavity and Fiber Cement Panel Siding Walls: Polyisocyanurate board.
 3. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder
 4. Fire Safing Insulation: Mineral wool batt insulation meeting fire rating requirements.
- B. Steel Strapping: 100 KSI minimum yield high tensile strength steel, galvanized, primed and then painted the specified color on the exposed side with a clear coat primer on the unexposed side. Minimum size shall be 0.02" x 1" x continuous length. The strap color shall be UVMAX 8 White, Extruded
- C. Fasteners: #12 x 3/4", plated self-drilling screws with sealing washers painted to match the specified color for fastening to light gauge steel (up to 12 GA purlins) or #12 x 1 1/4" plated self-drilling screws with sealing washers, painted to match the specified color for heavier gauge steel (up to 3/8" purlins/bar joist).
- D. Insulation System Fabric: Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene film. The fabric grade for the roof shall be Syseal FP (White),
- E. The fabric shall comply with UL/ULC 723 or ASTM E84, and be Class A compliant with a low flame spread index of 25 or less based on ASTM E84 test standards.
- F. Material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with minimum practical sealing to be done on job site. Fabric shall be folded to allow for rapid pull-out on the strap support system.
- G. Insulation system liner fabric perm rating shall be < 0.02 grains per hour per square foot based on ASTM E96.
- H. Sealants: Shall be Simple Saver System G524 High Tack Sealant for sealing vapor retarder laps.
- I. Insulation: Shall be fiberglass blanket or batt insulation meeting ASTM C991 Type 1, ASTM E136 and ASTM E84 or other insulation form as may be recommended and submitted by the system manufacturer and approved by the architect during submittals.
- J. Insulation Hangers: Shall be Fast-R preformed, rigid insulation hangers for supporting insulation between wall girts or roof purlins in roof pitches over 4:12. Coiled hangers are not allowed.
- K. Thermal Break: Thermal break shall be 3/16" thick by 3" wide white Quik-Stop Trash Free closed cell polyethylene foam with pre-applied adhesive film and peel-off backing. The selection shall be provided as thermal break where there is no existing thermal break and/or if additional depth space is desired.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

32 INSTALLATION

- A. Existing momentary disconnection and reattachment of light fixtures, electrical conduits, fire sprinkler system hangers, HVAC duct supports, etc. which may be attached to the roof structure shall be included in the scope of the project.
- B. Items that are not possible to temporarily disconnect may be left in place and a field splice made on the closest purlin, sealed and fastened for permanent attachment.
- C. Items to be permanently removed are noted on the project drawings or in the specifications. The responsibility for removal and disposal is the responsibility of the General Contractor.

33 FIELD QUALITY CONTROL

- A. Receive, inventory and store materials in a secure weatherproof environment. Store materials off the floor or ground if there is any risk of water damage from rain.
- B. Cut to length and install the painted steel straps or other support strapping if specified under "Products" or above in the pattern and spacing as shown on the project shop drawings. The straps are installed in tension, perpendicular to and at the bottom plane of the roof purlins.
- C. Position the pre-folded liner fabric on the strap platform, pull the liner system fabric out of its fold and fasten the fabric to the overlying purlins with the appropriate fastener. Liner system fabric shall be installed neatly and as wrinkle free as possible.
- D. Install the insulation materials on the fabric and strap platform at the specified thickness required to yield the resultant R-value of the insulation specified. Seal, fasten and trim the edges of the fabric liner to complete the installation.

34 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.

35 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072500 - WEATHER BARRIERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Air/Moisture Barriers: Materials that form a system to stop passage of air and moisture through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.2 RELATED REQUIREMENTS

- A. Section 071400 - Fluid Applied Waterproofing: Waterproofing system at select exterior conditions.
- B. Section 076200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.3 DEFINITIONS

- A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Airtight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
- C. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.4 REFERENCE STANDARDS

- AATCC Test Method 127 - Test Method for Water Resistance: Hydrostatic Pressure 2018, with Editorial Revision (2019).
- ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-- Tension 2016 (Reapproved 2021).
- ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay 2017.
- ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
- ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).
- ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials 2017.
- ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing 2015.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide product data for each product used.
- C. Certificate: Certificate stating that installed products meet or exceed specified requirements.

17 MOCK-UPS

- A. Install air barrier and water-resistive barrier materials in mock-up specified in Section 042613 - Masonry Veneer.
 - 1. Intent is to establish quality standard of wall assembly including all components.

18 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

19 SPECIAL BUILDING ENCLOSURE WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Installation Warranty for Building Rainscreen Assembly: Installer of exterior rainscreen assembly (including air/vapor barrier and attachments, framing, and exterior panels) to provide 10-year warranty that includes coverage for defective materials and/or workmanship. This warranty will also clearly include materials, labor, necessary activity to access these areas, and removal of any materials to effect repairs and restore to watertight conditions.

PART 2 PRODUCTS

21 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
 - 1. On outside surface of inside wythe of exterior masonry cavity walls use air barrier coating, fluid applied type.
 - 2. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.

22 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Water-Resistive Air Barrier Sheet, Mechanically Fastened:
 - 1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.
 - 3. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of 5 hours, when tested in accordance with AATCC Test Method 127.
 - 4. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 180 days of weather exposure.
 - 5. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.
 - 6. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.

7. Manufacturers:
 - a. DuPont Building Innovations; Tyvek Commercial Wrap D, Tyvek StuccoWrap (where indicated on drawings), with accessories recommended by manufacturer for project conditions
 - b. Typar, A Berry Global Inc. Company: Typar Drainable Wrap
 - c. Substitutions: See Section 016000 - Product Requirements.
- B. Air/Moisture Barrier Membrane- Fluid Applied:
 1. Material: Silica fortified rubber.
 2. Dry Film Thickness: 40 mils (0.040 inch), minimum.
 3. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 4. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F.
 5. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to three months of weather exposure.
 6. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 7. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
 8. Products:
 - a. BASF; MasterSeal AWB 665, with MasterSeal AWB 600 FL Block Filler preparation at concrete and masonry substrates.
 - b. Substitutions: See Section 016000 - Product Requirements.

23 ACCESSORIES

- A. Sealants, Tapes, Fasteners, Wall Penetration Flashings, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
 1. Include plastic cap washers for use with nails or screws.
- B. Flexible Flashing: Manufacturer's recommended self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 1. Flexible Flashing Schedule:
 - a. 9" flexible membrane at window sills and storefront head jambs.
 - b. 6" straight flashing at window jamb and head fins.
 - c. 9" straight flashing at storefront jambs.
 - d. 6" straight membrane at sheathing to foundation transition.
 - e. 18" straight flashing at all inside and outside sheathing corners.
 - f. 4" straight flashing for all transitions between metal flashings and the WRB.
- C. Flashing Panels at Vertical Wall Penetrations: Quickflash Weatherproofing Products; Flashing Panels for Wall Penetrations
- D. Thinners and Cleaners: As recommended by water-resistive barrier manufacturer.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

32 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

33 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Air/Moisture Barriers: Install continuous airtight, moisture resistant, barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Mechanically Fastened Exterior Sheets:
1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
 2. Overlap seams as recommended by manufacturer, 6 inches, minimum.
 3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches, minimum.
 4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
 5. Install water-resistive barrier over jamb flashings.
 6. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.
- E. Coatings:
1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
 2. Where exterior masonry veneer is being applied, install masonry anchors prior to placement of water-resistive barrier over masonry substrate; seal airtight around anchors.
 3. Apply bead or trowel coat of mastic sealant with minimum thickness of 1/4 inch along coating seams, rough cuts, and as recommended by manufacturer.
 4. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.
- F. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches onto water-resistive barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 - a. Verify that end dams at door and window sills are installed beyond sills in accordance with manufacturer's instructions.
 2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches wide and covering entire depth of framing.
 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches beyond face of jambs; seal water-resistive barrier to flashing.
 5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.
 - a. Flashing Panels at Vertical Wall Penetrations: Quickflash Weatherproofing Products; Flashing Panels for Wall Penetrations

34 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Owner's Inspection and Testing: Cooperate with Owner's testing agency.
 1. Allow access to work areas and staging.
 2. Notify Owner's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.
- C. Do not cover installed water-resistive barriers until required inspections have been completed.
- D. Obtain approval of installation procedures from water-resistive barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- E. Take digital photographs of each portion of installation prior to covering up weather barriers.

35 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION

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SECTION 072600 - UNDERSLAB VAPOR BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.3 REFERENCE STANDARDS

ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.

PART 2 PRODUCTS

2.1 MATERIALS

A. Under slab Vapor Barrier:

1. At occupied spaces:

a. Reinforced Aluminum Contaminant Vapor Barrier; 30-mil composite geomembrane comprised of flexible chemically resistant metalized film laminated to a geotextile, a copolymer polyethylene and a tear resistant PET reinforcement grid structure.

b. Manufacturers:

- 1) Land Science, a Division of Regenesys;
MonoShield; <https://landsciencetech.com>.
- 2) Substitutions: Not permitted.

2. At non-occupied spaces:

a. Water Vapor Permeance: Not more than 0.010 perms, maximum.

b. Complying with ASTM E1745 Class A.

c. Thickness: 15 mils.

d. Manufacturers:

- 1) Basis of Design: Stego Industries LLC; Stego Wrap Vapor Barrier
- 2) Other Acceptable Manufacturers:

(a) Henry

(b) Poly-America

(c) Raven Industries, Inc

(d) Reef Industries, Inc

(e) W. R. Meadows

(f) Substitutions: See Section 016000 - Product Requirements.

e. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

1.1 EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

12 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 074213.13 – FORMED METAL WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Composite metal panels.

1. Applications of composite include:

- a. Exterior installation of composite metal panels.
- b. Interior installation of composite metal panels.

B. Alternates: Products and installation included in this section are specified by alternates. Refer to Division 01 Alternates Section for alternates description and alternate requirements.

C. Related Sections: Section(s) related to this section include:

1. Cold-Formed Metal Framing: Division 05 Metal Framing Sections.
2. Sheet Metal Flashing and Trim: Division 07 Flashing and Trim Section.
3. Joint Sealers: Division 07 Joint Treatment Section.
4. Aluminum Windows: Division 08 Aluminum Windows Section.
5. Glazing: Division 08 Glass and Glazing Section.
6. Metal Framed Curtain Wall: Division 08 Curtain Wall Sections.

1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. ASTM International:

ASTM D1781 Standard Test Method for Climbing Drum Peel for Adhesives.

ASTM D1929 Standard Test Method for Determining Ignition Temperature of Plastics.

ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

ASTM E108 (Modified) Standard Test Methods for Fire Tests of Roof Coverings.

ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.

ASTM E283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.

ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Wall, and Doors By Uniform Static Air Pressure Difference.

C. American Architectural Manufacturers Association (AAMA):

AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

D. International Organization for Standardization (ISO):

ISO 9001-2015 Quality Management Systems - Requirements.

1.3 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer's SPEC-DATA sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.

1. Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets, and location and configuration of joints necessary to accommodate thermal movement.

D. Samples: Submit selection and verification samples for finishes, colors and textures.

1. Selected Samples: Manufacturer's color charts or chips illustrating full range of colors, finishes and patterns available for composite metal panels with factory applied finishes.

2. Verification Samples:

- a. Structural: 12 inch × 12 inch (305 × 305 mm) sample composite panels in thickness specified from an available stock color, including clips, anchors, supports, fasteners, closures and other panel accessories, for assembly approval. Include panel assembly samples not less than 24 inches × 24 inches (610 × 610 mm) showing 4-way joint.
- b. Include separate sets of drawdown samples on aluminum substrate, not less than 3 inches × 5 inches (76 × 127 mm), of each color and finish selected for color approval. Larger samples of standard colors are available with production-applied coatings.

E. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties, or a third party listing documenting compliance to a comparable code section and with specified performance characteristics and physical requirements.

F. Closeout Submittals: Submit the following:

1. Warranty: Warranty documents specified.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
 - a. Certificate: When requested, submit certificate indicating qualification.
2. Manufacturer Qualifications: Company with a minimum of 5 years of continuous experience manufacturing panel material of the type specified:

- a. Able to provide specified warranty on finish.
 - b. Able to provide a list of 5 other projects of similar size, including approximate date of installation and name of Architect for each.
 - c. Able to produce the composite material without outsourcing of the coating or laminating process.
 - d. Able to provide a certificate of registration to ISO 9001-2015.
3. Fabricator Qualifications: Company with at least 3 years of experience on similar sized metal panel projects and qualified by panel material manufacturer. Capable of providing field service representation during construction.
- B. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color (drawdown samples to be used for color approval of nonstandard coil coated colors), texture and pattern and workmanship standard. Comply with Division 01 Quality Control, Mock-Up Requirements Section.
1. Mock-Up Size: [Specify mock-up size].
 2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
 3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.
- C. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 01 Project Management and Coordination, Project Meetings Section.
- 1.5 DELIVERY, STORAGE & HANDLING
- A. General: Comply with Division 01 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
1. Protection: Protect finish of panels by applying heavy-duty removable plastic film during production.
 2. Delivery: Package composite wall panels for protection against transportation damage. Provide markings to identify components consistently with drawings.
 3. Handling: Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
- D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
1. Storage: Store panels in well-ventilated space out of direct sunlight.
 - a. Protect panels from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
 - b. Slope panels to ensure positive drainage of any accumulated water.
 - c. Do not store panels in any enclosed space where ambient temperature can exceed 120 degrees F (49 degrees C).

2. **Damage:** Avoid contact with any other materials that might cause staining, denting or other surface damage.

1.6 PROJECT CONDITIONS

- A. **Substrate Tolerances:** The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.
- B. **Field Measurements:** Verify locations of wall framing members and wall opening dimensions by field measurements prior to fabrication of MCM System. Indicate measurements on the "As Built Shop Drawings". Field measurements to be taken once all substrate materials and adjacent materials are installed.
- C. **Project Schedule:** Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

1.7 WARRANTY

- A. Contractor guarantees and warrants Work of this Section to be in compliance with Contract Documents and free from faults and defects in materials and workmanship for period of two years from Date of Substantial Completion.
- B. Provide Owner written Warranty for all fluoropolymer finishes for twenty years against blistering, peeling, or any other separation of coating from substrate, and against color loss of more than five NBS units.
- C. **Manufacturer's Warranty:** Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design: CENTRIA, BR5-36 Series Metal Wall Panels.**
 1. CENTRIA Architectural Systems; Tel: (800)759-7474; Web: www.CENTRIA.com.
- B. Morin Systems (Kingspan Corp)
- C. Pac-Clad 7.2 Series Exposed Fastener Panel
- D. Berridge "M" Series Exposed Fastener Panel

2.2 PANEL MATERIALS

- A. **Aluminum Face Sheet:** Smooth surface coil-coated, ASTM B209, 3003-H14 or 5052-H32 alloy.
 1. Face Sheet: **0.32 inch** nominal thickness.
 1. Surface: Smooth
- B. **Aluminum Products Recycled Content:** Average of postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.3 SYSTEM DESCRIPTION

- A. **Metal Wall Panels over Multi-Component Framed Wall System:** Single-skin exposed fastener metal wall panels applied as exterior rainscreen cladding over wall framing specified in Division 05 Section "Cold-Formed Metal Framing" with exterior

sheathing specified in Division 06 Section "Sheathing", an applied membrane that provides air, moisture, and water vapor control specified in Division 07 Section "Air Barriers", and insulation within the framing specified in Division 07 Section "Thermal Insulation." Metal wall panel installation specified in this Section includes secondary metal subgirt framing for panel attachment.

- B. **Metal Wall Panels over Masonry Wall System:** Single-skin concealed fastener metal wall panels applied as exterior rainscreen cladding over a masonry wall [and rigid board insulation] specified in Division 04 Section "Unit Masonry" and an applied membrane that provides air, moisture, and water vapor control specified in Division 07 Section "Air Barriers." Metal wall panel installation specified in this Section includes secondary metal subgirt framing for panel attachment.

2.4 METAL WALL PANEL ACCESSORIES

- A. General: Provide complete metal wall panel assembly incorporating trim, copings, fasciae, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Provide manufacturer's factory-formed shims, flashings, gaskets, & lap strips for a complete installation. Fabricate accessories in accordance with SMACNA Manual.
- B. Extruded Trim: Manufacturer's complementary aluminum extrusions for head, jamb, sill, base, flush, reveal, inside and outside corner, end wall, and expansion joint details. Finish to match metal wall panels.
1. Basis of Design: **CENTRIA, Microline Extrusions.**
- C. Mitered Corners: Structurally-bonded horizontal interior and exterior trimless corners matching metal wall panel material, profile, and factory-applied finish, fabricated and finished by metal wall panel manufacturer.
- D. Welded, riveted, fastened, or field- fabricated corners do not meet the requirements of this specification.
1. Basis of Design: **CENTRIA, MicroSeam Corners.**
- E. Formed Flashing and Trim: Match material, thickness, and color of metal wall panels.
- F. Sealants: Type recommended by metal wall panel manufacturer for application, meeting requirements of Division 07 Section "Joint Sealants."
- G. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
- H. Fasteners: Self-tapping screws and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply stainless steel fasteners with heads matching color of metal wall panels by means factory-applied coating.

2.5 SECONDARY METAL SUBGIRT FRAMING

- A. Miscellaneous Framing Components, General: Cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z180).
- B. Hat Channels: 0.06 inch/16 ga. (1.52 mm) minimum – nominal thickness.
- C. Sill Channels: 0.06 inch/16 ga. (1.52 mm) minimum – nominal thickness.

2.6 RELATED MATERIALS

- A. General: Refer to other related sections in Related Sections paragraph specified herein for related materials, including cold-form metal framing, flashing and trim, joint sealers, aluminum windows, glass and glazing and curtain walls.

2.7 FABRICATION

- A. General: Shop fabricate to sizes and joint configurations indicated on drawings.

1. Where final dimensions cannot be established by field measurements, provide allowance for field adjustment as recommended by the fabricator.
2. Form panel lines, breaks and angles to be sharp and true, with surfaces that are free from warp or buckle.
3. Fabricate with sharply cut edges and no displacement of aluminum sheet or protrusion of core.

2.8 FINISHES

A. Factory Finish: Lumiflon-based fluoropolymer resin coating that meets or exceeds values expressed in AAMA 2605 where relevant to coil coatings.

1. Color: As indicated as per the Contract Documents.

2.9 SOURCE QUALITY

A. Source Quality: Obtain composite panel products from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions.

3.2 EXAMINATION

A. Substrate Tolerances: The General Contractor is responsible for providing a substrate with a tolerance of 1/4 inch in 20.0 feet (6mm in 6m), on level, plumb, and location control lines as indicated and within 1/8 inch (3mm) offset of adjoining faces of alignment of matching profiles tolerances are noncumulative.

B. Field Measurements: Verify locations of wall framing members and wall opening dimensions by field measurements prior to fabrication of MCM System. Indicate measurements on the "As Built Shop Drawings". Field measurements to be taken once all substrate materials and adjacent materials are installed.

C. Project Schedule: Provisions in the project schedule must accommodate the time interval between field measurements and fabrication/installation.

3.3 PREPARATION

A. Surface Preparation: [Specify applicable product preparation requirements for installation of composite metal panels].

3.4 INSTALLATION

A. General:

1. Install panels plumb, level and true in compliance with fabricator's recommendations.
2. Anchor panels securely in place in accordance with fabricator's approved shop drawings.
3. Comply with fabricator's instructions for installation of concealed fasteners and with provisions of Section 079000 for installation of joint sealers.
4. Installation Tolerances: Maximum deviation from horizontal and vertical alignment of installed panels: 0.25 inch in 20 feet (6.4 mm in 6.1 m), noncumulative.

B. Related Products Installation Requirements: Refer to other sections in Related Sections paragraph herein for installation of related products.

3.5 FIELD QUALITY REQUIREMENTS

- A. Field Quality Control: Comply with panel system fabricator's recommendations and guidelines for field forming of panels.
- B. Fabricator's Field Services: Upon Owner's request, provide fabricator's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with fabricator's instructions.
 - 1. Site Visits: [Specify number and duration of periodic site visits].

3.6 ADJUSTING

A. Adjusting:

- 1. Repair panels with minor damage such that repairs are not discernible at a distance of 10 feet (3 m).
- 2. Remove and replace panels damaged beyond repair.
- 3. Remove protective film immediately after installation of joint sealers and immediately prior to completion of composite metal panel work.
- 4. Remove from project site damaged panels, protective film and other debris attributable to work of this section.

3.7 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.8 PROTECTION

- A. Protection: Protect installed product's finish surfaces from damage during construction.
 - 1. Institute protective measures as required to ensure that installed panels will not be damaged.

END OF SECTION

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SECTION 075600 – FLUID APPLIED ROOFING**PART 1 – GENERAL****1.1 SECTION INCLUDES**

- A. This specification is intended to outline the requirements for application of the Coating System, over approved roof substrates in acceptable condition.

1.2 RELATED SECTIONS

- A. Section 06100: Rough Carpentry: Roof blocking installation and requirements.
- B. Section 07620: Sheet Metal Flashing and Trim: Metal flashing and counter flashing installation and requirements.
- C. Section 15430: Plumbing Specialties: Roof drains, scuppers, gutters and downspout installation and requirements.

1.3 REFERENCES

- A. Factory Mutual (FM Global) – Approval Guide.
 - 1. Factory Mutual Standard 4470 – Approval Standard for Class 1 Roof Covers.
- B. Underwriters Laboratories (UL) - Roofing Systems and Materials Guide (TGFU R1306).
- C. ASTM International (ASTM) – Annual Book of ASTM Standards.
 - 1. ASTM D 1079 – Standard Terminology Relating to Roofing, Waterproofing, and Bituminous Materials.
 - 2. ASTM D 1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films.
 - 3. ASTM D 4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 4. ASTM D 4798 / D4798M – 1- Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method).
 - 5. ASTM D 6083 - Standard Specification for Liquid Applied Acrylic Coating Used in Roofing
 - 6. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 7. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
 - 8. ASTM G 26 - Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.
 - 9. ASTM G 53 - Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials.
- D. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.
- E. National Roofing Contractors Association (NRCA).
- F. American Society of Civil Engineers (ASCE).
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

1.4 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

1.5 SYSTEM DESCRIPTION

- A. The Coating System scope of work includes roofing, flashing and reinforcing of joints and junctions, and roof accessories integrally related to roof installation.
- B. Final determination of the fitness of the system, or its components, for any given roof may not be made by any representative other than a member of Manufacturer's Field Services Department.
- C. Provide an installed roofing membrane and base flashing system that does not permit the passage of water, and will withstand the design pressures calculated in accordance with the current revision of ASCE 7.
- D. Manufacturer shall provide all primary roofing materials that are physically and chemically compatible when installed in accordance with existing application requirements.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data:
 - 1. Provide product data sheets for each type of product indicated in this section.
- C. Shop Drawings:
 - 1. Provide Manufacturers standard details and approved shop drawings for the system specified.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: MANUFACTURER shall provide a roofing system that meets or exceeds the criteria listed in this section.
- B. Installer Minimum Qualifications:
 - 1. Installer shall be classified as an Authorized Contractor as defined and a certified by Manufacturer.
- C. Source Limitations: Components listed shall be provided by a single Manufacturer or approved by the primary roofing Manufacturer.

1.8 PRE-INSTALLATION CONFERENCE

- A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, architect, owner, Manufacturer representative and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions, agreements, and open issues and furnish copies of recorded discussions to each attending party. The primary purpose of the meeting is to review foreseeable methods and procedures related to roofing work.
 - 1. Tour representative areas of roofing substrates to inspect and discuss conditions of substrate, penetrations and other preparatory work to be performed.
 - 2. Review Coating System requirements (Coating System specifications, detail drawings and the Contract Documents).
 - 3. Review required submittals, both completed and in progress.
 - 4. Review and finalize the construction schedule related to roofing work, and verify availability of materials, installer's personnel, equipment and facilities needed to consistently make progress and avoid delays.
 - 5. Review required inspection(s), testing, and certifying, and material usage accounting procedures. Review forecasted weather conditions.
 - 6. Establish procedures for coping with unfavorable conditions, including the possibility of temporary roofing work.

1.9 REGULATORY REQUIREMENTS

- A. Work shall be performed in a safe, professional manner, conforming to federal, state and local codes.
- B. UL Listing: Provide Coating Roofing System and component materials which have been evaluated by Underwriters Laboratories for flame-spread, and are listed in the "Underwriters Laboratory Roofing Materials and Systems Directory" for Class A construction over existing metal or other non-combustible roofing (Flame-spread shall pass ASTM E-108 and/or UL 790). Provide roof covering materials bearing UL approval marking on the container. This indicates that the material has been subjected to UL's examination, test procedures and follow-up inspection service.

1.10 DELIVERY, STORAGE & HANDLING

- A. Store and handle Coating System materials in a manner that will ensure there is no possibility of contamination.
- B. Store in a dry, well ventilated, weather tight location at temperatures between 50°F (10°C) and 90°F (32°C) until the products are ready to be applied (keep from freezing). Do not stack material pallets more than two (2) high.
- C. Do not subject existing roof to unnecessary loading of stockpiled materials.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.11 PROJECT CONDITIONS

- A. Weather:
 - 1. Proceed with roofing only when existing and forecasted weather conditions permit.
 - 2. Ambient temperatures shall be above 50°F (10°C) and rising when applying water based coatings.
- B. Proceed with roofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with Coating System recommendations and guarantee requirements as follows:
 - 1. Do not begin work if precipitation is expected within twenty-four hours of application, or if temperatures are expected to fall below 50°F (10°C) during the duration of the job.
 - a. FlexSeal™ Sealant may be used in temperatures lower than 42°F (6°C).
 - 2. Upper temperature restriction (both air and substrate) for application of Coating System products is 110°F (43°C). If substrate temperatures exceed 110°F (43°C), Coating System products shall be applied during cooler periods of the day. If this is not practical, the substrate shall be cooled with water, and then Coating System products applied just after the water has flashed-off.
 - 3. No moisture may be present when applying Coating System products. Taking into consideration the UV curing properties of HydroStop® PremiumCoat®, allow for sufficient daylight hours necessary for curing of materials.

1.12 WARRANTY

- A. Liquid Applied Emerald Pledge™ Limited Warranty: Manufacturers standard form, in which GAF agrees to repair leaks through the Coating System products on the roof caused by manufacturing defects or natural deterioration of the Coating System roofing system.
 - 1. Warranty Duration:
 - a. Twenty (20) Years Labor and Material

PART 2 – PRODUCTS

1.13 MANUFACTURER

- A. Acceptable Manufacturer: GAF, Commercial Roofing Products Division
- B. Substitutions: Must be approved by the OWNER and the ARCHITECT.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

1.14 COATINGS

- A. Coating System Finish Coat: An acrylic, permanently flexible, highly UV-resistant, chemical-resistant elastomeric compound fully reinforced with a tough stitch-bonded polyester fabric designed for roofing and flashing applications of all types.
 - 1. Application Rate: 0.75-1.00 gal per 100 ft² (3.05 – 4.07 L/10 m²) per coat.
 - 2. Application Method: Roof brush or 1” (25.4 mm) nap roller.
 - 3. Application Temperature (air, surface): 50°F (10°C) - 110°F (43°C).
 - 4. Dry time: (touch dry) 1- 4 hours at 77°F (25°C), 40% R.H. (full cure): 7 days.
- B. Coating System Foundation Coat: An acrylic, permanently flexible, highly UV-resistant, chemical-resistant elastomeric compound fully reinforced with a tough stitch-bonded polyester fabric designed for roofing and flashing applications of all types.
 - 1. Application Rate: 1.00-1.50 gal per 100 ft² (4.07 - 6.11 L/10 m²) per coat.
 - 2. Application Method: Roof brush.
 - 3. Application Temperature (air, surface): 50°F (10°C) - 110°F (43°C).
 - 4. Dry time: (touch dry) 1- 4 hours at 77°F (25°C), 40% relative humidity (full cure): 7 days.

1.15 FLASHINGS, FABRIC, AND BULKING AGENTS

- A. Coating System Flashing: A high volume solids for low shrinkage providing increased tensile strength and elongation on problem roof areas. It is ideally suited for sealing mechanical fasteners and horizontal seams on metal roofs, as well as around flashings, drains and protrusions.
 - 1. Application Rate: 2.0 gal per 200 linear feet with a 6 inch width (7.6 L per 61 linear meters with a 152 mm width); 2 coats typically required.

2. Application Method: Putty knife, spatula and stiff bristle brush.
 3. Application Temperature (ambient): minimum 50 °F (10 °C).
 4. Dry Time: 1-4 hours depending on application thickness
 5. Clean-up: Water before curing.
- B. HydroStop® Hydrofiber Bulking Agent: This product is comprised of glass fibers that, when mixed with one of the above listed products, will create a thick, workable compound used to fill voids, level surfaces, and create cants. Also used for flashing details, metal roof seams, inside and outside flashing details, round stacks, pipe legs, pitch pockets, conduit pipes, expansion joints, etc.
1. Application Rate: 0.50 gal per 100 ft² (2.03 L/10m²) per 1 gal of Coating System Foundation or Finish Coat.
 2. Application Method: Brush.
 3. Application Temperature (air, surface): 50°F (10°C) - 110°F (43°C).
 4. Dry Time: Minimum 24 hours.
 5. Clean up: Water.

1.16 PRIMERS AND SEALANTS

- A. Application: Based on the existing conditions and a thorough inspection as determined by the pre-installation conference, the installer will use all primer materials necessary to provide the owner a complete and warrantable installation.
- B. Materials: The application shall consist of any single or combination of the following:
1. Acrylex 400 Primer: A water-based, medium viscosity material, providing corrosion protection, flash rust resistance and enhanced adhesion over steel, aluminum and galvanized metal surfaces. Single component, premium quality exterior acrylic latex primer that is blister and stain resistant, permanently flexible and highly durable. It exhibits excellent corrosion resistance over metal substrates and alkali resistance over concrete and masonry.
 - a. Application Rate: 0.33 – 0.67 gal per 100 ft² (1.34 – 2.73 L/10 m²) depending on substrate, surface and porosity.
 - b. Application Method: Brush, roller or conventional or airless sprayer.
 - c. Application Temperature (air, surface): 50°F (10°C) – 110°F (43°C).
 - d. Dry Time: 75°F (24°C), 50% relative humidity, 20-30 minutes
 2. Lock-Down Primer: Single component, moisture cured, low viscosity, aluminized polyurethane primer designed to enhance adhesion of coatings to sound, stable, moderately corroded metal, or to provide a thin protective finish where desired.
 - a. Application Rate: 0.25 gal per 100 ft² (1.02 L/10 m²).
 - b. Application Method: Roller or airless sprayer.
 - c. Application Temperature (air, surface): 50°F (10°C) – 110°F (43°C).
 - d. Dry Time: (to touch) 75°F (24°C), 50% relative humidity: Approximately 1 hour. (To cure) 75°F (24°C), 50% relative humidity: Approximately 12 hours.
 - e. Dry Time: 1-2 hours at 70°F (21°C), 50% relative humidity.
 3. FlexSeal™ Sealant: White, solvent-based synthetic elastomeric compound designed to line and waterproof interior and exterior gutters typically found in metal buildings. FlexSeal™ Sealant is capable of withstanding ponding water. This product is easiest to apply at temperatures over 42°F.
 - a. Application Rate: 2.0 gal per 200 linear feet with a 6 inch width (7.6 L per 61 linear meters with a 152 mm width); 2 coats typically required.
 - b. Application Method: Roller or airless sprayer.
 - c. Application Temperature (air, surface): 20°F (-6.6°C) - 120°F (49°C).
 - d. Dry Time: 75°F (24°C), 50% relative humidity: Approximately 24 hours.

PART 3 – EXECUTION

1.17 SUBSTRATE CONDITIONS

- A. Installer shall verify adhesion. Questionable substrates shall be directed to MANUFACTURER's Field Services Department for resolution.
- B. Follow MANUFACTURER's Substrate Preparation Guidelines at Manufacturer.com.

1.18 SYSTEM APPLICATION

- A. Refer to individual addenda at the end of this guide specification for preparation and application requirements for specific substrates.
 - 1. Addendum 1 – Resurfacing Metal Substrate.
 - 2. Addendum 2 – Resurfacing Metal Substrate with HydroStop® and Kymax™.

1.19 INSPECTION INFORMATION

- A. Inspect Preliminary Work/Flashing Details for problem areas (e.g., gaps, cracks, fishmouths, air pockets, etc.) to ensure that work is complete and satisfactory.
- B. Inform Project Architect and Owner when all preliminary work and flashing details will be complete and the Installer is ready to proceed with application of Coating System.
- C. Any final roofing installation prior to this interim inspection is subject to rejection by the Project Architect and/or the Owners Consultant.

1.20 OTHER ITEMS

- A. Installer shall take photographs of representative roof areas, including detail work, before work commences, after the surface has been properly prepared, after all flashing and detail work has been performed, and after the spray application of the Coating System membrane.
- B. Special care shall be taken to avoid shading when spraying dark Coating System Roofing Membrane colors.
- C. Installer shall take special care when moving spray hoses and other equipment on the roof so that flashing work and encapsulated fastener heads are not damaged.
- D. If there will be an extended period of time between application of base and finish coats, the base coat shall be thoroughly cleaned before applying the finish coat.

1.21 REPAIRS

- A. In the event that the Coating System membrane is damaged or punctured, repairs are to be performed using the Coating System Finish Coat as follows:
 - 1. Damaged areas are to be cut, cleaned and dried.
 - 2. Apply Coating System Flashing or Coating System finish Coat and feather out onto the existing Coating System membrane.
 - 3. If a new penetration area has been cut, embed Coating System Fabric into the Coating System flashing according to standard Coating System specifications.
 - 4. Once the Coating System Flashing has cured, Coating System Finish Coat may be applied for aesthetic uniformity.

3.6 PREPARATION OF SUBSTRATE

- A. Preparation of the Roof substrate is the responsibility of the Installer. Installer shall address and correct all of the conditions listed in this section. Examine substrates to receive new roofing. Do not proceed with installation of the Coating System roofing system until unsatisfactory conditions have been corrected in a manner acceptable to the Manufacturer (MANUFACTURER).
- B. Repair of Dented / Damaged Panels: Installer shall repair dented and/or damaged metal roof panels. Dents shall be mechanically removed to the maximum extent possible. If ribs are broken, Installer shall cover the broken rib area with a sheet metal cap.
- C. Re-tightening and Replacement of Fasteners: All fasteners shall be re-tightened, secured or replaced, as necessary. All stripped fasteners shall be replaced with larger diameter fasteners, and the area re-secured by adding a new fastener next to the one that was stripped. All missing fasteners shall be replaced.
- D. Thorough Cleaning / Removal of Existing Paints and Coatings: Metal substrate shall be pressure-washed with water. A minimum working pressure of 3,000 psi (20 MPa) shall be used to remove all delaminating paint and coatings dirt, dust, and waste products (oil, oil-based roof cements, solvents, grease, animal fats, etc.). All existing silicone-based sealants shall be completely removed from roof substrate prior to application of Coating System products.

- E. Treatment of Rust Areas: Remove all loose, flaking or powdery rust by wire brushing if it has not been removed during the pressure washing. Use appropriate primer prior to coating. Roof panels which are corroded to the point where holes are present shall be replaced.
- F. Priming of Pre-Finished Metal Panels: Where roof panel surfaces are known or suspected to contain Kynar-500 or other fluoropolymers, test patches shall be prepared with and without the use of XR-2000 Primer. Based on test patch adhesion results, Installer shall apply XR-2000 Primer on pre-finished metal panels per specifications. Please note that since XR-2000 Primer has rust inhibiting properties, primer is not required where XR-2000 Primer has been used.

3.7 FIELD OF ROOF APPLICATION AND RATES

- A. Resurfacing Metal Substrate with HydroStop® and Kymax™ 20 year System:
 - 1. Before applying the Coating System, an adhesion test is required to ensure an adhesion minimum of 2.0 PLI. Test patches to be applied with the system rates listed below.
 - 2. Tighten and/or replace existing fasteners.
 - 3. Pressure wash roof to ensure it is free of dirt, debris, oil, and other contaminants that could negatively affect adhesion. United Cleaning Concentrate (UCC) is recommended to clean the roof. Allow the roof to completely dry.
 - 4. Treat Seams:
 - a. **Horizontal seams:** are to be 3-coursed with Coating System Butter Grade at a rate of 2.0 gal per 100 ft² (8.15 L/10 m²), embed fabric, and apply Coating System Butter Grade at a rate of 2.0 gal per 100 ft² (8.15 L/10 m²).
 - b. **Vertical seams:** Overlap and trapezoidal seams requires treatment with 2.0 gal per 100 ft² (8.15 L/10 m²) of Coating System Butter Grade. All other vertical seams may forgo treatment **IF** the seal/tape is intact on the seam or is double locked.
 - 5. After a minimum of 24 hours has elapsed, inspect the final roof surface for any deficiencies. All unsatisfactory conditions must be repaired.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.
 - b. Penetrations in horizontal assemblies.
 - c. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. Hilti North America.
 - c. Specified Technologies Inc.
 - d. Tremco Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
 - 1.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

- A. Refer to Drawings for Basis-of-Design Fire Stopping Designs and design number.

END OF SECTION 078413

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SECTION 079213 - ELASTOMERIC JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag Gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.
- D. Owner-provided field quality control.

1.2 RELATED REQUIREMENTS

- A. Parking Structure Drawings and Specifications: Construction/control joint requirements at parking structure.
- B. Section 072500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- C. Section 078400 - Firestopping: Firestopping sealants.
- D. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.
- E. Section 088000 - Glazing: Glazing sealants and accessories.
- F. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.3 REFERENCE STANDARDS

- ASTM C661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.
- ASTM C794 Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.
- ASTM C834 Standard Specification for Latex Sealants 2017.
- ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications 2019.
- ASTM C920 Standard Specification for Elastomeric Joint Sealants 2018.
- ASTM C1087 Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- ASTM C1193 Standard Guide for Use of Joint Sealants 2016.
- ASTM C1248 Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
- ASTM C1311 Standard Specification for Solvent Release Sealants 2014.
- ASTM C1330 Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid- Applied Sealants 2018.
- ASTM C1521 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).
- ASTM D2240 Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).
- SWRI (VAL) SWR Institute Validated Products Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.
 5. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.
- B. Sealant Schedule indicating locations of use.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Certificate: Certificate stating that installed products meet or exceed specified requirements.
- 12 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
1. Adhesion Testing: In accordance with ASTM C794.
 2. Compatibility Testing: In accordance with ASTM C1087.
 3. Allow sufficient time for testing to avoid delaying the work.
 4. Deliver to manufacturer sufficient samples for testing.
 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
 2. Name(s) of sealant manufacturers' field representatives who will be observing
 3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Substrate: if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Test method used.
 - g. Date of installation of field sample to be tested.
 - h. Date of test.
 - i. Copy of test method documents.
 - j. Age of sealant upon date of testing.

- k. Test results modeled after the sample form in the test method document.
 - l. Indicate use of photographic record of test.
- E. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
 1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.
- F. Field Quality Control Plan:
 1. Visual inspection of entire length of sealant joints.
 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to Owner.
 2. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
 3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- B. Field Adhesion Test Procedures:
 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 2. Have a copy of the test method document available during tests.
 3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
 4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer and report any deficiencies.
 6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

- C. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
 - D. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
 - 1. Sample: At least 18 inches long.
 - 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
 - 3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.
 - E. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.
- 12 WARRANTY
- B. See Section 017800 - Closeout Submittals, for additional warranty requirements.
 - C. Correct defective work within a five-year period after Date of Substantial Completion.
 - D. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

11 GENERAL

- A. Provide non-staining, non-corrosive elastic compound as required.
- B. Provide joint sealants at windows and differential materials.
- C. Sealants shall be paintable where used on painted surfaces and shall match the wall material on non-painted surfaces.

11 EMISSIONS

- A. Adhesives and sealants located inside the waterproofing envelope shall be in accordance with one of the following, as applicable.
 - 1. The emission levels shall be in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product shall be certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix D.
 - 2. GreenSeal GS-36.
 - 3. SCAQMD Rule 1168 in accordance with Table 901.10(3) in the National Green Building Standards, excluding products that are sold in 16-ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations.

12 MANUFACTURERS

- A. Security Sealant: Single-component, pick-resistant, moisture-curing, aliphatic, non-sag, polyurethane sealant for security,

ASTM C920 Type S, Grade NS, Class 25, Use NT, T, M, A, G and O., Classification MCG-S-25-A-N, No. 81026; CFIA

- B. Provide products from the following manufacturer:
 - Master Builders Solutions
 - 889 Valley Park Drive
 - Shakopee, MN 55379 USA
 - www.master-builders-solutions.com/en-us
- B. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Basis of Design: Sika Masterseal CR 195
 - 2. Substitutions: Not allowed for this Product
- C. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
 - 1. Master Builders Solutions (BASF)
 - 2. Sika Corporation:
 - 3. Substitutions: Not Allowed for this Product

13 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - 1) Exception: Such gaps and openings in gypsum board and plaster finished stud walls and suspended ceilings.
 - 2) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - c. Other joints indicated below.
 - 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.

- B. Exterior Joints (General Purpose): Use non-sag paintable silicone sealant, unless otherwise indicated or noted below.
 - 1. Masonry Joints: Use low-modulus silicone sealant in color to match adjacent masonry.
 - C. Interior Joints (General Purpose): Use non-sag paintable acrylic emulsion latex sealant, unless otherwise indicated or noted below.
 - 1. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
 - 2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - 3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 - 4. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
 - 5. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
 - D. Interior Wet Areas: Restrooms; fixtures in wet areas include plumbing fixtures and countertops.
 - E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".
 - 1. Basis of Design: Pecora; AC-20FTR
- 14 NONSAG JOINT SEALANTS
- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 4. Color: To be selected by Architect from manufacturer's standard range.
 - B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Color: To be selected by Architect from manufacturer's standard range.
 - C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 - 1. Color: White or as otherwise selected by Architect from manufacturer's standard range.
 - D. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
 - 1. Movement Capability: Plus and minus 35 percent, minimum.
 - 2. Color: To be selected by Architect from manufacturer's standard range.
 - E. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.

1. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
 2. Color: To be selected by Architect from manufacturer's standard range.
- F. Tamper-Resistant Polyurethane Sealant: ASTM C920, Grade NS, Uses M, G, and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: (N/A).
 2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
- G. Epoxy Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Hardness Range: 65 to 75, Shore D, when tested in accordance with ASTM C661.
 2. Color: To be selected by Architect from manufacturer's standard range.
- H. Polysulfide Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: (N/A).
 2. Color: To be selected by Architect from manufacturer's standard range.
- I. Polysulfide Sealant for Continuous Water Immersion: Polysulfide; ASTM C920, Grade NS, Uses M and A; single component; explicitly approved by manufacturer for continuous water immersion; not expected to withstand traffic.
1. Movement Capability: (N/A).
 2. Color: To be selected by Architect from manufacturer's standard range.
- J. Acrylic-Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; paintable; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Color: White.
- K. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's standard range.
 2. Manufacturers:
- L. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
1. Color: To be selected by Architect from manufacturer's standard range.
- M. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.
- 12 SELF-LEVELING SEALANTS
- A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.

2. Color: To be selected by Architect from manufacturer's standard range.
 - B. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi- component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
 - C. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 1. Color: To be selected by Architect from manufacturer's standard range.
 - D. Self-Leveling Silyl-Terminated Polyether/Polyurethane (STPE/STPU) Sealant: ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus and minus 35 percent.
 2. Color: To be selected by Architect from manufacturer's standard range.
 - E. Self-Leveling Polysulfide Sealant: ASTM C920, Grade P, Uses M and A; multicomponent; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent.
 2. Color: To be selected by Architect from manufacturer's standard range.
 - F. Rigid Self-Leveling Polyurethane Joint Filler: Two-part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.
 1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.
 - G. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 1. Composition: Multi-component, 100 percent solids by weight.
 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 3. Color: To be selected by Architect from manufacturer's standard colors.
 4. Joint Width, Minimum: 1/8 inch.
 - H. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
 2. Color: To be selected by Architect from manufacturer's standard colors.
- 12 ACCESSORIES
- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi- Cellular Polyethylene.
2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi- Cellular Polyethylene.
3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 - a. Provide at exterior applications and all other applications subject to moisture or water intrusion.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify Architect and Contractor approved Sealant Schedule. Refer to paragraph 1.04 Submittals for schedule submittal requirements.
- B. Verify that joints are ready to receive work.
- C. Verify that backing materials are compatible with sealants.
- A. Verify that backer rods are of the correct size.
- B. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 3. Arrange for sealant manufacturer's technical representative to be present during tests.
 4. Record each test on Preinstallation Adhesion Test Log as indicated.
 5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

33 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

34 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

35 FIELD QUALITY CONTROL

- A. Owner will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
- D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- E. Repair destructive test location damage immediately after evaluation and recording of results.

11 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire-rated hollow metal doors and frames.
- C. Thermally insulated hollow metal doors with frames.
- D. Sound-rated hollow metal doors and frames.
- E. Accessories, including glazing and louvers.

1.2 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 088000 - Glazing: Glass for doors and borrowed lites.
- C. Section 099113 - Exterior Painting: Field painting.
- D. Section 099123 - Interior Painting: Field painting.

1.3 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SDI: Steel Door Institute.
- G. UL: Underwriters Laboratories.

1.4 REFERENCE STANDARDS

- ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames 2019.
- ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.
- ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- ASTM C476 - Standard Specification for Grout for Masonry 2020.
- ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- ASTM E413 - Classification for Rating Sound Insulation 2016.

- BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
- ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- ITS (DIR) - Directory of Listed Products current edition.
- NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames 2012.
- NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.
- NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames 2018.
- NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
- NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.
- NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
- SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.
- UL (DIR) - Online Certifications Directory Current Edition.
- UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions. BB. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

15 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Certificate: Certificate stating that installed products meet or exceed specified requirements.

12 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Mock-up: Include sample door in integrated exterior mock-up per Section 014000 Quality Requirements.
- D. Maintain at project site copies of reference standards relating to installation of products specified.

13 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

21 MANUFACTURERS

- A. Commercial Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company
 - 2. Mesker, dormakaba Group
 - 3. Republic Doors, an Allegion brand
 - 4. Steelcraft, an Allegion brand
 - 5. Substitutions: See Section 016000 - Product Requirements.

22 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush and Two Panel, as indicated on drawings. Visible joints or seams on exposed faces are prohibited.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush.
 - 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the

requirements specified for exterior doors and for sound-rated doors;
where two requirements conflict, comply with the most stringent.

23 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 2. Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - 3. Door Thickness: 1-3/4 inch, nominal, unless otherwise noted on drawings.
 - 4. Weatherstripping: Refer to Section 087100.
- C. Interior Doors, Non-Fire Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Thickness: 1-3/4 inch, nominal, unless otherwise noted on drawings.
- D. Fire-Rated Doors:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
 - e. Zinc Coating (at exterior doors): A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - 3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Attach fire rating label to each fire rated unit.
 - 4. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following:
 - a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.

- b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
- c. Label: Include the "S" label on fire-rating label of door.
5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inch, nominal, unless otherwise noted on drawings.

24 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Exterior Door Frames: Fixed Throat.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
 3. Frame Finish: Factory finished.
 4. Casing: As selected by Architect from manufacturer's standard options.
 5. Weatherstripping: Separate, see Section 087100.
- C. Interior Door Frames, Non-Fire Rated: Fixed Throat.
 1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
 2. Frame Finish: Factory finished.
 3. Casing: As selected by Architect from manufacturer's standard options.
- D. Door Frames, Fire-Rated: Fixed Throat.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
 3. Frame Finish: Factory primed and field finished.
 4. Casing: As selected by Architect from manufacturer's standard options.
- E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- F. Transom Bars: Fixed, of profile same as jamb and head.
- G. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- H. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

25 FINISHES

- A. Primer at Doors: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish at Frames: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
 1. Color: As selected by Architect from manufacturer's standard range.
- C. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

26 ACCESSORIES

1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
 2. Style: Standard straight slat blade.
 3. Fasteners: Concealed fasteners.
- B. Glazing: As specified in Section 088000, factory installed.
- C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws
- D. Astragals for Double Doors:
1. Exterior Doors: Steel, Z-shaped.
 2. Fire-Rated Doors: Steel, shape as required for fire rating.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- G. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- H. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

32 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

33 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install prefinished frames after painting and wall finishes are complete.
- C. Install fire rated units in accordance with NFPA 80.
- D. Coordinate frame anchor placement with wall construction.
- E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- F. Install door hardware as specified in Section 087100.
- G. Coordinate installation of electrical connections to electrical hardware items.

H. Touch up damaged factory finishes.

34 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

35 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

36 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

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SECTION 08 1416 FLUSH WOOD DOORS

PART 1 GENERAL

11 SECTION INCLUDES

- A. Pre-hung, flush wood doors; flush; fire rated and non-rated.

12 RELATED REQUIREMENTS

- A. Section 062000 - Finish Carpentry: Wood door trim.
- B. Section 081113 - Hollow Metal Doors and Frames.
- C. Section 087100 - Door Hardware.
- D. Section 088000 - Glazing.

13 REFERENCE STANDARDS

16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

ANSI A135.4 - Basic Hardboard 2012 (R2020).

ANSI A208.1 - American National Standard for Particleboard 2016.

ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).

ASTM E413 - Classification for Rating Sound Insulation 2016.

AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

AWMAC (GIS) - Guarantee and Inspection Services Program Current Edition.

AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0 2021.

NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.

NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.

NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.

UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.

UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2013.

14 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 2. Include certification program label.

- C. Certificate: Certificate stating that installed products meet or exceed specified requirements.
 - D. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing.
 - E. Manufacturer's Installation Instructions: Indicate special installation instructions.
 - F. Warranty, executed in Owner's name.
 - 1. Life of installation.
 - 1. Provide for finished replacement. Include labor, materials, and site final finish.
- 15 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- 16 DELIVERY, STORAGE, AND HANDLING
- A. Package, deliver and store doors in accordance with specified quality standard.
 - B. Accept doors on site in manufacturer's packaging and inspect for damage.
 - C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.
- 17 PROJECT CONDITIONS
- A. Coordinate the work with door opening construction, door frame and door hardware installation.
- 18 WARRANTY
- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
 - B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
 - C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS**21 MANUFACTURERS**

- A. As selected from the approved list of:
 - 1. Lambton Doors
 - 2. Masonite Architectural
 - 3. Oshkosh Door Company
 - 4. VT Industries (Eggers)
- B. Substitutions must be requested and Approved by the Architect.

22 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick, solid core construction, and pre-hung. See drawings for trim requirements. Coordinate hinge finish with hardware schedule in Section 087100 - Door Hardware.
 - 1. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 2. Smoke and Draft Control Doors (Indicated on the Architectural Door Schedule): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

23 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

24 DOOR FACINGS

- A. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.
- B. Facing Adhesive: Type I - waterproof.

12 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Provide solid blocks at lock edge for hardware reinforcement.
 - 1. Provide solid blocking for other through bolted hardware.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
 - F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
 - 1. Exception: Doors to be field finished.
 - G. Provide edge clearances in accordance with the quality standard specified.
- 13 ACCESSORIES
- A. Hollow Metal Door Frames: See Section 081113.
 - B. Glazed Openings:
 - 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 - 2. Fire-Protection-Rated Glass: Safety Certification, 16 CFR 1201, Category II.
 - 3. Glazing: Single vision units, 1/4 inch thick glass.
 - 4. Tint: Clear.
 - C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

32 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Field-Finished Doors: Trimming to fit is acceptable.
- C. Adjust width of non-rated doors by cutting equally on both jamb edges.
 - 1. Trim maximum of 3/4 inch off bottom edges.
 - 2. Trim fire-rated doors in strict compliance with fire rating limitations.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.
- G. Install door louvers plumb and level.

33 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

14 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

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SECTION 083100 - ACCESS DOORS AND PANELS**PART 1 GENERAL****11 SECTION INCLUDES**

- A. Wall mounted access units.
- B. Ceiling mounted access units.
- C. Floor access door and frame units, interior and exterior.

12 RELATED REQUIREMENTS

- A. Section 099113 - Exterior Painting: Field paint finish.
- B. Section 099123 - Interior Painting: Field paint finish.
- C. Division 22: Plumbing components requiring access.
- D. Division 23: Mechanical components requiring access.
- E. Division 26: Electrical components requiring access.

13 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products current edition.
- B. UL (FRD) - Fire Resistance Directory Current Edition.

14 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- C. Certificate: Certificate stating that installed products meet or exceed specified requirements.

15 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

16 PROJECT CONDITIONS

- A. Coordinate the work with other work requiring access doors.

PART 2 PRODUCTS**21 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection[and temperature-rise limit] ratings indicated, in accordance with NFPA 252 or UL 10B for vertical fire-rated access door assemblies, and ASTM E119 or CAN/ULC S101 for horizontal fire-rated access door assemblies.

22 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Panel Material: Aluminum extrusions with gypsum board inlay.
 - 2. Size: 12 by 12 inch, unless otherwise indicated on drawings.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.

5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
 6. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.
- B. Fire-Rated, Flush Access Panels with Concealed Flanges
1. Basis-of-Design Product: Subject to compliance with requirements, provide Cendrex Inc.; PFI-GYP Fire-Rated Insulated Access Door with Drywall Bead Flange or a comparable product by one of the following:
 - a. Babcock-Davis.
 - b. Maxam Metal Products Limited.
 2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
 3. Optional Features: Gasketing, Piano hinges.
 4. Locations: As indicated by the Architectural Drawings
 5. Door Size: As indicated by the Architectural Drawings.
- C. Anti-Ligature Security Flush Access Panels with Concealed
1. Material: 16-gauge cold rolled steel door and frame.
 2. Hinge: Continuous piano hinge. Hinge location: Hinges must be located on the second dimension (height).
 3. Locking mechanism: Key operated cylinder cam latch
 4. Flange: 22-gauge galvanized steel, 1 1/8" drywall bead flange
 5. Frame: 1 5/8" in depth, made of cold rolled steel
- D. Rough opening: Door sizes + 1/4 " or + 6mm
- E. Gasketing: Neoprene around perimeter of door frame
- F. Finish: High quality white powder coat primer

23 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 2. Keys: Furnish two keys per lock and key all locks alike.
 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware".
- F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.
- G. Fill, and grind joints to ensure flush and square unit.

24 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.
 - a. Color: As selected by Architect from full range of industry colors.
- E. Stainless Steel Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.

- b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify surrounding finish and door compatibility.
- B. Verify that rough openings are correctly sized and located.

12 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

13 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

END OF SECTION

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors.
- C. Weatherstripping.
- D. Door hardware.

1.2 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 087100 - Door Hardware: Hardware items other than specified in this section.
- C. Section 088000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

- AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.
- AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2014.
- AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
- AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
- AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
- ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
- ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).
- ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015.

SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

14 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

12 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
 - 1. Provide product data for each product used. Include test data indicating compliance with the performance criteria.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include structural and thermal calculations of the system.
 - 2. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Certificate: Certificate stating that installed products meet or exceed specified requirements.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

13 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Mock-up: Include sample storefront in integrated exterior mock-up per Section 014000 Quality Requirements.

14 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

15 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

17 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

- B. Provide five-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

21 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally Broken:
 - 1. Basis of Design: YKK AP; YES 45 TU Thermally Broken Center Set Storefront System with 1" insulated glass infill per Section 088000 Glazing
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

22 BASIS OF DESIGN -- SWINGING DOORS

- A. Medium Stile, Monolithic Glazing:
 - 1. Location: Interior storefront doors.
 - 2. Basis of Design: YKK AP; 35D Medium Stile Standard Swing Door with 1/4" glass infill per Section 088000 Glazing: www.ykkap.com
- B. Medium Stile, Insulating Glazing, Thermally Broken:
 - 1. Location: Exterior storefront doors.
 - 2. Basis of Design: YKK AP; MegaTherm 35XT Commercial Swing Door with 1" glass infill per Section 088000 Glazing: www.ykkap.com/
 - 3. Thickness: 2-3/8 inches, nominal.

23 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage, and attachment devices.
 - 1. Finish: As selected by Architect from manufacturer's standard options.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

24 PERFORMANCE REQUIREMENTS

- A. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - 1. Design Wind Loads: Comply with requirements of applicable code.
 - 2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

- B. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
- C. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
- D. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
- E. Overall U-value Including Glazing: .45 Btu/(hr sq ft deg F), maximum, or as otherwise indicated on drawings.

26 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Glazing Stops: Flush.
 - 2. Cross-Section: 4 1/2 x 2 inch nominal dimension.
 - a. Extruded aluminum framing members shall be of thickness required and reinforced as required to support imposed loads.
 - 3. Provide solid perimeter frames or sealed frame fillers for support of perimeter backer rods and sealants.
- B. Glazing: As specified in Section 088000.
- C. Doors: Glazed aluminum.
 - 1. Top Rail: 2-11/16 inches wide.
 - 2. Vertical Stiles: 2-11/16 inches wide.
 - 3. Bottom Rail: 10 inches wide, per accessibility code requirements.
 - 4. Glazing Stops: Square.
 - 5. Finish: As selected by Architect from manufacturer's standard options.

27 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: Aluminum sheet, 20-gauge, 0.032-inch minimum thickness; finish to match framing members.
- D. Concealed Flashings: Galvanized steel, 26-gauge, 0.0179-inch minimum base metal thickness.
- E. Concealed Flashings: Stainless steel, 26-gauge, 0.0187-inch minimum thickness.
- F. Concealed Flashings: Sheet aluminum, 26-gauge, 0.017-inch minimum thickness.
- G. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- H. Sealant for Setting Thresholds: Non-curing butyl type.
- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- J. Glazing Accessories: As specified in Section 088000.
- K. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- L. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

28 FINISHES

- A. Finish: As selected by Architect from manufacturer's standard options, either Class I Anodized or AAMA 2605 Superior Performing polyvinylidene fluoride (PVDF) organic coating.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

29 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: As specified in Section 087100 and on drawings.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.
- F. Sub-sills: Provide factory sub-sills. Include sealed end dams and seal to weather barrier at rough openings.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

32 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form watertight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of sealant and secure.
- K. Install hardware using templates provided.
 - 1. See Section 087100 for hardware installation requirements.
- L. Install glass and infill panels in accordance with Section 088000, using glazing method required to achieve performance criteria.

- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
- 33 TOLERANCES
- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
 - B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- 34 FIELD QUALITY CONTROL
- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
 - B. See Section 014000 - Quality Requirements, for general testing and inspection requirements.
 - C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - D. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
 - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
 - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 - 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
 - A. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.
 - B. Any failure shall be corrected and retested until it passes and one additional assembly tested and passing.
- 31 ADJUSTING
- A. Adjust operating hardware and sash for smooth operation.
- 32 CLEANING
- A. Remove protective material from pre-finished aluminum surfaces.
 - B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
 - C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
 - D. Remove excess sealant by method acceptable to sealant manufacturer.
- 33 PROTECTION
- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 06 Section "Rough Carpentry"
2. Division 06 Section "Finish Carpentry"
3. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
4. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
5. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.2 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.3 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in

vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.

- c. Indicate complete designations of each item required for each opening, include:
- 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:

- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.4 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply

with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.

2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Inspect and discuss electrical roughing-in for electrified door hardware.
- d. Review sequence of operation for each type of electrified door hardware.
- e. Review required testing, inspecting, and certifying procedures.
- f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.7 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage L Series: 10 years
 - b) Schlage ND Series: 10 years
 - c) Schlage ALX Series: 10 years
 - d) Sargent: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 10 years
 - b) Sargent: 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - b) LCN 1460 Series: 30 years
 - c) LCN 4050 Series: 25 years
 - d) LCN 1450 Series: 25 years
 - e) LCN 1260 Series: 20 years
 - f) LCN 1250 Series: 15 years
 - g) LCN Concealed: 15 years
 - h) Sargent SC Series: 10 years
 - i) Sargent Concealed: 5 years
 - 4) Automatic Operators
 - a) LCN: 2 years
 - b) Sargent: 1 year
 - b. Electrical Warranty
 - 1) Locks
 - a) Schlage: 3 years

- b) Sargent: 1 years
- 2) Exit Devices
 - a) Von Duprin: 3 years
- 3) Closers
 - a) LCN: 2 years

1.8 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 012500.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. McKinney TB series
 - b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.4 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Ives 700 series
2. Acceptable Manufacturers:
 - a. ABH
 - b. Select

B. Requirements:

1. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
2. Provide pin and barrel continuous hinges fabricated from 14-gauge, type 304 stainless steel.
3. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
4. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide pin and barrel continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Select
 - b. ABH

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.6 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.7 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.8 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
 - a. Accurate 9000/9100 series
 - b. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.

2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Connections – provide quick-connect Molex system standard.
8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.9 DEADBOLTS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage B600/B700/B800 Series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DL3000 Series
 - b. Sargent D100 Series

B. Requirements:

1. Provide grade 1 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer's standard strike.
5. Lock Status Indicator Trim: Where specified, provide escutcheon with lock status indicator widow.
 - a. Escutcheon height 4.125 inches, width 2.54 inches. Projection 1.32 inches on thumbturn side and 1.28 inches on cylinder side.
 - b. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

- c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
- d. Indicator window to provide 180-degree visibility.

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
 - a. Detex Advantex series
 - b. Precision APEX 2000 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
2. Acceptable Manufacturers and Products:

- a. Folger Adam 300 Series
- b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 MAGNETIC LOCKS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Schlage
2. Acceptable Manufacturers:
 - a. Securitron
 - b. Security Door Controls

B. Requirements:

1. Provide magnetic locks certified to meet ANSI/BHMA A156.23 classification criteria, UL10C, and UL1034 for burglary-resistant electronic locking mechanisms.
2. Provide magnetic locks equipped with SPDT Magnetic Bond Sensing device, where specified, to monitor whether enough magnetic holding force exists to ensure adequate locking and SPDT Door Status Monitor device, where specified, to monitor whether door is open or closed. Provide bond sensors fully concealed within electromagnet to resist tampering or damage.
3. Provide fasteners, mounting brackets, and spacer bars required for mounting and details.
4. Provide power supply recommended and approved by manufacturer of magnetic locks.
5. Where magnetic locks are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of magnetic locks for each individual leaf. Switches control both doors simultaneously at pairs. Locate controls as directed by Architect.

2.13 PASSIVE INFRARED MOTION SENSORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage SCAN II Series
2. Acceptable Manufacturers and Products:
 - a. Securitron XMS Series
 - b. Security Door Controls MD-31D Series

B. Requirements:

1. Provide motion sensors as specified in hardware groups.

2.14 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage Everest 29 T
2. Acceptable Manufacturers and Products:
 - a. No Substitute
 - b. Best CORMAX
 - c. Corbin-Russwin Patented and Restricted Keyway
 - d. Medeco Keymark
 - e. Sargent DG2
 - f. Yale Keymark
 - g. Assa Maximum+
 - h. Sargent Signature

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Restricted: cylinder with permanent core with patented, restricted keyway.
 - b. Patented Restricted: cylinder with interchangeable core with patented, restricted keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.15 KEYING

A. Scheduled System:

1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.

- b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
- d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.16 KEY CONTROL SYSTEM

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Telkee
- 2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

B. Requirements:

- 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.17 DOOR CLOSERS

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:

- a. Corbin-Russwin DC8000 series
- b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.18 CONCEALED CLOSERS – HIGH SECURITY

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 2210 series
2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

1. Provide high security concealed door closers at doors conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Provide heavy duty, single-acting closers with single lever arm and roller assembly
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.

8. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
9. Provide special templates, drop plates, mounting brackets, and adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.19 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.20 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.21 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson
 - b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.22 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.23 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Zero International
2. Acceptable Manufacturers:
 - a. National Guard
 - b. DHSI

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.24 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns

b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.25 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

B. FINISH: BHMA 630 (US32D); EXCEPT:

1. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
2. Door Closers: Powder Coat to Match
3. Weatherstripping: Clear Anodized Aluminum
4. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 4. Installation Guide for Doors and Hardware: DHI TDH-007-20

- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
1. Install construction cores to secure building and areas during construction period.
 2. Replace construction cores with permanent cores as indicated in keying section.
 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
1. Conduit, junction boxes and wire pulls.
 2. Connections to and from power supplies to electrified hardware.
 3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Connections to panel interface modules, controllers, and gateways.
 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

HARDWARE SET NO. L01

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | CONT. HINGE | 112XY TWP CON | ✓ 628 | IVE |
| 1 | EA | AUTO FLUSH BOLT | FB31P | 630 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | 626 | IVE |
| 1 | EA | EL MORTISE LOCK | L9095JEL HSLR 09-663 CON 12/24 VDC | ✓ 630 | SCH |
| 2 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | COORDINATOR | COR X FL | 628 | IVE |
| 2 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 1 | | WEATHERSTRIPPING | BY DOOR MANUFACTURER | | |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 2 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |

DOOR NORMALLY CLOSED AND LOCKED BOTH SIDES . VALID CREDENTIAL EITHER SIDE TO MOMENTARILY UNLOCK DOOR. DOOR WILL UNLOCK BOTH DIRECTIONS ON LOSS OF POWER OR FIRE ALARM.

HARDWARE SET NO. L02

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------|-------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | PASSAGE SET | L9010 HSLR 09-662 | 630 | SCH |
| 1 | EA | WALL STOP | LR-WS | 630 | ACC |

HARDWARE SET NO. L03

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------|-------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | PASSAGE SET | L9010 HSLR 09-662 | 630 | SCH |
| 1 | EA | WALL STOP | LR-WS | 630 | ACC |

HARDWARE SET NO. L04

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|--------------|----------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | MORTISE LOCK | CH 9143i-SEC | 630 | ACC |
| 1 | EA | WALL STOP | LR-WS | 630 | ACC |

HARDWARE SET NO. L05

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | WALL STOP | LR-WS | 630 | ACC |

HARDWARE SET NO. L06

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L07

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L08

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|-----------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L09

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|-----------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L10

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|---------------------------|-----------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | FACULTY RESTROOM/HOTEL | L9485J HSLR 09-666 10-072 | 630 | SCH |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | LR-WS | 630 | ACC |

HARDWARE SET NO. L11

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|-----------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | INSTITUTION LOCK | L9082J HSLR 09-663 | 630 | SCH |
| 2 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6211 FS 12/16/24/28 VAC/VDC | ⚡ 630 | VON |
| 1 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | GASKETING | 700NA TORX | BK | NGP |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 2 | EA | CREDENTIAL READER | BY DIVISION 28 | ⚡ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ⚡ | |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ⚡ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED BOTH SIDES . VALID CREDENTIAL EITHER SIDE TO MOMENTARILY UNLOCK DOOR. DOOR WILL UNLOCK BOTH DIRECTIONS ON LOSS OF POWER OR FIRE ALARM.

HARDWARE SET NO. L12

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------|-------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | PASSAGE SET | L9010 HSLR 09-662 | 630 | SCH |
| 1 | EA | OH STOP | 100S | 630 | GLY |

HARDWARE SET NO. L13

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L14

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|-----------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | OH STOP | 100S | 630 | GLY |
| 1 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. L15

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT TW8 | ✓ 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6211 FSE 12/16/24/28 VAC/VDC | ✓ 630 | VON |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✓ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ✓ | |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ✓ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL TO MOMENTARILY UNLOCK DOOR. DOOR WILL REMAIN LOCKED ON SECURE SIDE UPON LOSS OF POWER OR FIRE ALARM. FREE EGRESS AT ALL TIMES.

HARDWARE SET NO. L16

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT TW8 | ✓ 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6211 FSE 12/16/24/28 VAC/VDC | ✓ 630 | VON |
| 1 | EA | OH STOP | 100S | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✓ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ✓ | |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ✓ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL TO MOMENTARILY UNLOCK DOOR. DOOR WILL REMAIN LOCKED ON SECURE SIDE UPON LOSS OF POWER OR FIRE ALARM. FREE EGRESS AT ALL TIMES.

HARDWARE SET NO. L17

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|-----------------------------|--------|-----|
| 2 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 2 | EA | PANIC HARDWARE | PA-9847-EO-LBR | 626 | VON |
| 2 | EA | MAGNETIC LOCK | M490 12/24 VDC | ✎ 628 | SCE |
| 2 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 2 | EA | KICK PLATE | 8400 10" X 1" LDW B-CS TKTX | 630 | IVE |
| 2 | EA | WALL STOP | LR-WS | 630 | ACC |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✎ | |
| 2 | EA | DOOR CONTACT | BY DIVISION 28 | ✎ | |
| 1 | EA | MOTION SENSOR | SCANII 12/24 VDC | ✎ WHT | SCE |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED BOTH SIDES. VALID CREDENTIAL/MOTION SENSOR TO MOMENTARILY UNLOCK DOOR. DOOR WILL UNLOCK BOTH DIRECTIONS ON LOSS OF POWER OR FIRE ALARM.

HARDWARE SET NO. R01

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|--------------------|----------------------|---------|-----|
| 2 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | PANIC HARDWARE | 9847-EO | 626 | VON |
| 1 | EA | PANIC HARDWARE | 9847-TL-OP-376T | 626 | VON |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 2 | EA | 90 DEG OFFSET PULL | 8190EZHD 10" O | 630-316 | IVE |
| 2 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | | WEATHERSTRIPPING | BY DOOR MANUFACTURER | | |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 2 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |

HARDWARE SET NO. R02

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|--------------------|------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | CLASSROOM DEADBOLT | B663J | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | PUSH PLATE | 8200 4" X 16" | 630 | IVE |
| 1 | EA | PULL PLATE | 8303 10" 4" X 16" | 630 | IVE |
| 1 | EA | OH STOP | 90S | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R03

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|---------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | OFFICE/ENTRY LOCK | L9050J 06A L583-363 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R04

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | | |

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. R05

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|------------------|----------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | | WEATHERSTRIPPING | BY DOOR MANUFACTURER | | |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | | |

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. R06

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R07

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |

HARDWARE SET NO. R08

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 EDA | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R09

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |

HARDWARE SET NO. R10

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------------------|------------------------|--------|-----|
| 6 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | AUTO FLUSH BOLT | FB41P | 630 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | 626 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | COORDINATOR | COR X FL | 628 | IVE |
| 2 | EA | MOUNTING BRACKET | MB | 689 | IVE |
| 2 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 2 | EA | KICK PLATE | 8400 10" X 1" LDW B-CS | 630 | IVE |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 1 | EA | MEETING STILE GASKETING | 8217SBK PSA | BK | ZER |

HARDWARE SET NO. R11

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | OH STOP | 90S | 630 | GLY |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R12

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|--------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | OH STOP | 90S | 630 | GLY |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R13

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | CLASSROOM LOCK | L9070J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ⚡ | |

DOOR CONTACT TIED TO ACCESS CONTROL SYSTEM FOR MONITORING.

HARDWARE SET NO. R14

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | PANIC HARDWARE | LD-98-NL | 626 | VON |
| 1 | EA | RIM HOUSING | 20-079 | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6111 FSE 12/24 VAC/VDC | ⚡ 630 | VON |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ⚡ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ⚡ | |
| 1 | EA | MOTION SENSOR | SCANII 12/24 VDC | ⚡ WHT | SCE |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ⚡ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL TO MOMENTARILY UNLOCK DOOR.
DOOR WILL REMAIN LOCKED ON SECURE SIDE UPON LOSS OF POWER OR FIRE ALARM. FREE
EGRESS AT ALL TIMES.

HARDWARE SET NO. R15

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J 06A | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6211 FSE 12/16/24/28 VAC/VDC | ✓ 630 | VON |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✓ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ✓ | |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ✓ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL TO MOMENTARILY UNLOCK DOOR. DOOR WILL REMAIN LOCKED ON SECURE SIDE UPON LOSS OF POWER OR FIRE ALARM. FREE EGRESS AT ALL TIMES.

HARDWARE SET NO. R16

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 700-HT | 630 | IVE |
| 1 | EA | STOREROOM LOCK | L9080J HSLR 09-663 | 630 | SCH |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6211 FSE 12/16/24/28 VAC/VDC | ✓ 630 | VON |
| 1 | EA | H-SEC CONC CLOSER | 2210 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 1 | EA | GASKETING | 700NA TORX | BK | NGP |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✓ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ✓ | |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ✓ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL TO MOMENTARILY UNLOCK DOOR. DOOR WILL REMAIN LOCKED ON SECURE SIDE UPON LOSS OF POWER OR FIRE ALARM. FREE EGRESS AT ALL TIMES.

HARDWARE SET NO. R17

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | PASSAGE SET | L9010 06A | 630 | SCH |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 1 | EA | GASKETING | 488SBK PSA | BK | ZER |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R18

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|--------------------------------------|---------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | PRIVACY LOCK W/ OUTSIDE INDICATOR | L9040 06A L583-363 OS-OCC | 630 | SCH |
| 1 | EA | SURFACE CLOSER | 4011 | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

HARDWARE SET NO. R19

Provide each with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------------|------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 112XY | 628 | IVE |
| 1 | EA | PANIC HARDWARE | LD-98-NL | 626 | VON |
| 1 | EA | FSIC CORE | 23-030 | 626 | SCH |
| 1 | EA | ELECTRIC STRIKE | 6111 FSE 12/24 VAC/VDC | ✓ 630 | VON |
| 1 | EA | SURFACE CLOSER | 4111 SCUSH | 689 | LCN |
| 1 | | WEATHERSTRIPPING | BY DOOR MANUFACTURER | | |
| 1 | EA | RAIN DRIP | 142AA | AA | ZER |
| 1 | EA | DOOR SWEEP | 39A | A | ZER |
| 1 | EA | THRESHOLD | 655A | A | ZER |
| 1 | EA | CREDENTIAL READER | BY DIVISION 28 | ✓ | |
| 1 | EA | DOOR CONTACT | BY DIVISION 28 | ✓ | |
| 1 | EA | MOTION SENSOR | SCANII 12/24 VDC | ✓ WHT | SCE |
| 1 | EA | POWER SUPPLY | BY DIVISION 28 | ✓ | |
| 1 | EA | DIAGRAM | ELEVATION | | DLR |
| 1 | EA | DIAGRAM | POINT TO POINT | | DLR |

END OF SECTION

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SECTION 088000 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds.

1.2 RELATED REQUIREMENTS

- A. Section 072500 - Weather Barriers.
- B. Section 079200 - Joint Sealants: Sealants for other than glazing purposes.
- C. Section 081113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- D. Section 081416 - Flush Wood Doors: Glazed lites in doors.
- E. Section 084313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
- F. Section 084435 - Protective Framed Glazing Assemblies: Glazing fire-tested as part of wall assembly.

1.3 REFERENCE STANDARDS

- 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.
- ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
- EN-14179 - Glass in Building – Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass.
- GANAs (GM) - GANA Glazing Manual 2008.
- GANAs (SM) - GANA Sealant Manual 2008.
- ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
- ITS (DIR) - Directory of Listed Products current edition.
- NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
- NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).
- NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.
- 14 ADMINISTRATIVE REQUIREMENTS
- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.
- 12 SUBMITTALS
- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide technical data to include, but not be limited to, structural, physical, and environmental characteristics, and size limitations.
- C. National Green Building Standard: Submit data required by National Green Building Standard ICC 700.
- D. Samples: Submit two samples 12 by 12 inch in size of each glazing type.
- E. Certificate: Certificate stating that installed products meet or exceed specified requirements.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- 13 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Heat Soak Testing: Provide heat soak testing for all fully tempered monolithic glass per EN-14179.
- 14 MOCK-UPS
- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide on-site glazing mock-up with the specified glazing components.
- C. Locate where directed.
- D. Mock-ups may remain as part of the Work.
- 15 FIELD CONDITIONS
- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
- 16 WARRANTY
- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

21 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. AGC Glass Company North America, Inc
 - 2. Cardinal Glass Industries
 - 3. Guardian Industries Corp
 - 4. Pilkington North America Inc
 - 5. Vitro Architectural Glass (formerly PPG Glass)

22 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Design Pressure: Calculated in accordance with ASCE 7.
 - 2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 4. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
 - 1. In conjunction with weather barrier related materials described in other sections, as follows:
 - a. Water-Resistive Barriers: See Section 072500.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 - 3. Solar Optical Properties: Comply with NFRC 300 test method.
- D. Sound Transmission Performance:
 - 1. OITC (Outside-Inside Transmission Class): Exterior 1" insulated glass applications - 30.
 - 2. STC (Sound Transmission Class): Interior 1/4" monolithic glass applications - 31.

23 GLASS MATERIALS

- A. Float Glass: Provide float glass-based glazing unless otherwise indicated.
 - 1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 - 2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 - 3. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing

glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

24 INSULATING GLASS UNITS

A. Insulating Glass Units - General

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Warm-Edge Spacers: Polypropylene warm-edge technology design.
 - a. Spacer Height: Manufacturer's standard.
 - b. Manufacturers:
 - 1) Technoform Glass Insulation; TGI-Spacer
 - 2) Substitutions: See Section 016000 - Product Requirements.
4. Spacer Color: As selected by Architect from manufacturer's standard range of options.
5. Purge interpane space with dry air, hermetically sealed.
6. Capillary Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet between point of fabrication and point of installation to permit pressure equalization of air space.
 - a. Capillary Tubes: Tubes to remain open and be of length and material type in accordance with insulating glass fabricator's requirements.
 - b. Inert gas may be installed in the field into air space in accordance with insulating glass fabricator's and installer's requirements.

B. **Type GL1, GL2 (Tempered)** - Insulating Glass Units: Vision glass, double glazed.

1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum. Fully temper where indicated on drawings and required by prevailing building code.
 - a. Tint: Clear.
 - b. Coating: Low-E (solar control type), on #2 surface.
4. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum. Fully temper where indicated on drawings and required by prevailing building code.
 - a. Tint: Clear.
5. Total Thickness: 1 inch.
6. Thermal Transmittance (U-Value): Refer to drawings.
7. Visible Light Transmittance (VLT): 50 percent, minimum.
8. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
9. Visible Light Reflectance, Outside: 10 percent, maximum.
10. Glazing Method: Dry glazing method, gasket glazing.

25 GLAZING UNITS

A. **Type GL11** - Monolithic Interior Vision Glazing:

1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Heat-strengthened float glass. Fully temper where indicated on drawings and required by prevailing building code.
3. Tint: Clear.
4. Thickness: 1/4-inch, nominal.
5. Glazing Method: Dry glazing method, gasket glazing.

25 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3-inch-long by one half the height of the glazing stop by thickness to suit application, self-adhesive on one face.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

26 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

PART 3 EXECUTION

31 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

32 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

33 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
 - C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
 - D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
 - E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
 - F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following: weld splatter, fire-safing, plastering, mortar droppings, etc.
- 34 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)
- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
 - B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 - C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
 - D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.
- 35 CLEANING
- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
 - B. Remove nonpermanent labels immediately after glazing installation is complete.
 - C. Clean glass and adjacent surfaces after sealants are fully cured.
 - D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.
- 36 PROTECTION
- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
 - B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 090561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Broadloom carpet.
 - 3. Carpet tile.
 - 4. Thin-set ceramic tile and stone tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.2 RELATED REQUIREMENTS

- A. Section 017419 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.
- B. Section 033000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.
- C. Section 035400 - Cast Underlayment: Self-leveling underlayment.

1.3 REFERENCE STANDARDS

- ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
- ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Include certification of accuracy by authorized official of testing agency.
 - 7. Submit report to Architect.
 - 8. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.

16 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

13 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS – (NOT USED)**PART 3 EXECUTION****31 CONCRETE SLAB PREPARATION**

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 - 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 - 3. Preliminary cleaning.

4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
7. Specified remediation, if required.
8. Patching, smoothing, and leveling, as required.
 1. Other preparation specified.
 2. Adhesive bond and compatibility test.
 3. Protection.

32 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

33 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

34 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

35 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

36 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

37 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

11 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Resilient sound isolation clips.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Acoustic (sound-dampening) wall and ceiling board.

12 RELATED REQUIREMENTS

- A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 061000 - Rough Carpentry: Building framing and sheathing.
- C. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- D. Section 072500 - Weather Barriers: Water-resistive barrier over sheathing.
- E. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- F. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

13 REFERENCE STANDARDS

- AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2018).
- ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
- ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2018.

- ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2020.
- ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
- ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel 2017.
- ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing 2018.
- ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Editorial Revision (2020).
- ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
- ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- ASTM E413 - Classification for Rating Sound Insulation 2016.
- GA-600 - Fire Resistance and Sound Control Design Manual, 22nd edition 2018.
- ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).

14 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing.
- C. Certificate: Certificate stating that installed products meet or exceed specified requirements.

12 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum five years of documented experience.

PART 2 PRODUCTS

21 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 1. Clark Dietrich Building Systems LLC

2. Marino Ware
 3. Phillips Manufacturing Co
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
1. Studs: C-shaped with knurled or embossed faces.
 2. Runners: U shaped, sized to match studs.
 3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
 4. Resilient Furring Channels: Single leg configuration; 1/2 inch channel depth.
 - a. Products:
 - 1) Same manufacturer as other framing materials.
 5. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
 - a. Products:
 - 1) Clark Dietrich; Sound Clip (CDSC)
 - 2) PAC International, Inc; RSIC-1
 - 3) Substitutions: See Section 016000 - Product Requirements.
- C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings
 4. X Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
 - a. Products:
 - 1) Clark Dietrich
 - 2) FireTrak Corporation; Posi Klip
 - 3) Metal-Lite, Inc; The System
 - 4) Super Stud Building Products, Inc
 - 5) Substitutions: See Section 016000 - Product Requirements.
 5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
- A. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
Products:
Clark Dietrich
Substitutions: See Section 016000 - Product Requirements.
- E. Preformed Top Track Firestop Seal:

1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
 2. Products:
 - 1) Hilti, Inc; Top Track Seal CFS TTS
 - 2) Specified Technologies Inc; SpeedFlex TTG Track Top Gasket
 - 3) Substitutions: See Section 016000 - Product Requirements.
- F. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
- G. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
- 22 BOARD MATERIALS
- A. Basis-of-Design Gypsum Board Products: Except as otherwise specified, products of USG Corporation are named herein to establish quality and design standards for gypsum board materials.
- B. Other Acceptable Manufacturers: Subject to compliance with all requirements of this specification, provide named products and systems or comparable products and systems by one of following:
1. American Gypsum Company
 2. Georgia-Pacific Gypsum
 3. National Gypsum Company
 4. Substitutions: See Section 016000 - Product Requirements.
- C. Gypsum Wallboard: Abuse Resistant Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut. Basis of Design: USG Sheetrock, "Mold tough VHI Firecode X Panels", 5/8-inch thick x 4'-0" wide x 8'-0" with tapered edges, Type X.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required at all locations.
1. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 2. Thickness:
 - a. Vertical Surfaces: 5/8 inch, Type "X".
 - b. Ceilings: 5/8 inch, Type "C".
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- D. Backing Board For Wet Areas:

1. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings, and behind kitchen and bath sinks.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178.
 - a. Regular Type: Thickness 5/8 inch.
 - b. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
 - c. Products:
 - 1) Georgia-Pacific Gypsum; DensShield Tile Backer
 - 2) National Gypsum Company; Gold Bond eXP Tile Backer
 - 3) Substitutions: See Section 016000 - Product Requirements.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 5/8 inch.
 3. Edges: Tapered.
 4. Products:
 - a. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board
 - b. Substitutions: See Section 016000 - Product Requirements.
- F. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper-faced, high- density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
1. Thickness: 1/2 inch.
 2. Long Edges: Tapered.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Products:
 - a. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board
 - b. Substitutions: See Section 016000 - Product Requirements.
- G. Gypsum Sheathing Board: Glass mat faced both sides, moisture resistant, silicone treated core type; sized to minimize joints in place; Georgia Pacific Dens-Glas-Gold or BPB GlasRoc.
1. Application: Exterior sheathing, unless otherwise indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 5. Core Type: Regular and Type X, as indicated.
 6. Type X Thickness: 5/8 inch.
 7. Regular Board Thickness: 5/8 inch.
 8. Edges: Square.
 9. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensGlass Sheathing

- a. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing
 - a. National Gypsum Company; Gold Bond eXPSheathing
 - b. Substitutions: See Section 016000 - Product Requirements.
- 23 GYPSUM WALLBOARD ACCESSORIES
- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch, or as otherwise indicated on drawings.
 - B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Products:
 - a. Basis of Design: Pecora; AC-20FTR
 - b. Franklin International, Inc
 - c. Liquid Nails, a brand of PPG Architectural Coatings
 - d. Sherwin Williams
 - e. Substitutions: See Section 016000 - Product Requirements.
 - C. Water-Resistive Barrier: As specified in Section 072500.
 - D. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
 - G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.
 - H. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

32 FRAMING INSTALLATION

- A. Metal Framing: Except at UltraSteel install in accordance with ASTM C 754 and manufacturer's instructions. At UltraSteel install in accordance with UL V450, UL V438 or UL U419 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.

2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
 - D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
 - E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, per manufacturer's recommended orientation and spacing, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
 - G. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
- 33 ACOUSTIC ACCESSORIES INSTALLATION
- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
 - B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Place continuous bead at perimeter of each layer of gypsum board.
 3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.
- 35 BOARD INSTALLATION
- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
 - B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
 - C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
 - D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
 - E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.

2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
 - F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.
 - G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
 - H. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.
- 36 INSTALLATION OF TRIM AND ACCESSORIES
- A. Control Joints: (Note: If drawings do not indicate control joints spaced as required by manufacturer and as below, Contractor to notify Architect for spacing diagram prior to installation.) Place control joints consistent with lines of building spaces and as follows:
 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 2. At exterior soffits, not more than 30 feet apart in both directions.
 - B. Corner Beads: Install at external corners, using longest practical lengths.
 - C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- 37 JOINT TREATMENT
- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
 - B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
 - C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1.
 2. Level 4: Walls and ceilings exposed to view and to receive flat or eggshell paint finish or wall coverings, unless otherwise indicated.
 3. Level 3: Mechanical closets, and where indicated on drawings.
 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 6. Level 0: Temporary partitions.
 7. Level 0: Surfaces indicated to be finished in later stage of project.
 - D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 - B. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.
- 38 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

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SECTION 093013 – CERAMIC TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

- A. Section 035400 - Cast Underlayment.
- B. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- C. Section 092116 - Gypsum Board Assemblies: Glass-mat, water resistant tile backer board.

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specification for the Installation of Ceramic Tile (Compendium); current edition.
- B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
 - 1. Submit to jobsite for Owner and Interior Designer review and approval.
- D. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
- E. Certificate: Certificate stating that installed products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

2. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
- 17 MOCK-UP
 - A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
 - B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 1. Minimum size of mock-up is indicated on drawings.
 2. Approved mock-up may remain as part of the Work.
- 18 DELIVERY, STORAGE, AND HANDLING
 - A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
- 12 FIELD CONDITIONS
 - A. Do not install solvent-based products in an unventilated environment.
 - B. Maintain ambient and substrate temperature above 50 degrees F and below 90 degrees F during installation and curing of setting materials.
- 1.10 SOURCE LIMITATIONS
 - A. Obtain all surface preparation and installation materials from a single source manufacturer to assure compatibility and to be in compliance with manufacturers Full System Warranty.
- 1.11 WARRANTY
 - A. Provide to the Owner a Full System Warranty from the installation materials manufacturer for a period of not less than 10 Years from Date of Substantial Completion.

PART 2 PRODUCTS

- 21 TILE
 - A. **TYPE PTF-1:** Unglazed porcelain tile shall be standard/first grade quality as manufactured by Mosaic (formally Crossville Inc.) and shall conform to the requirements of ANSI A137.1 - 2021.
 1. Size: Porcelain tile shall be manufactured to specific size after firing and shall be Nominal 12" x 24". All measurements are in inches unless otherwise specified.
 2. Type: Porcelain tile shall be Matte Finish
 3. Thickness: Porcelain tile shall be manufactured to specific thickness after firing and shall be nominal 8.0 mm or greater for large unit tile.
 4. Color and Pattern as approved by the Architect.
 5. Base (**Type PTB-1**): Provide unpolished Bullnose shapes and matching trim shapes such as corners, borders and cove base when required by the documents to match field tile.
 6. Product Test Data:
 - a. Water Absorption (ASTM C373): < 0.5%.
 - b. Breaking Strength (ASTM C648): >325 lbf.

- c. Bond Strength (ASTM C482): >50 psi.
 - d. Dynamic Coefficient of Friction (ANSI A326.3-2021): > .42% wet.
- B. **TYPE CWT-1:** Polished Ceramic Wall Tile shall be standard/first grade quality as manufactured by Mosaic (formally Crossville Inc.) and shall conform to the requirements of ANSI A137.1 - 2021.
1. Size: Ceramic tile shall be manufactured to specific size after firing and shall be Nominal 2" x 10". All measurements are in inches unless otherwise specified.
 2. Type: Tile shall be white body ceramic
 3. Thickness: Porcelain tile shall be manufactured to specific thickness after firing and shall be nominal 9.0 mm or greater for large unit tile.
 4. Color and Pattern as approved by the Architect.
 5. Provide unpolished Bullnose shapes and matching trim shapes such as corners, borders and cove base when required by the documents to match field tile.
 6. Product Test Data:
 - a. Water Absorption (ASTM C373): < 7%.
 - b. Breaking Strength (ASTM C648): >125 lbf.
 - c. Warping Strength (ASTM C485): >.75 psi.
 - d. Chemical Resistance as per ANSI C650 - Unaffected.
- 22 TILE BACKING MATERIALS
- A. Tile backing materials installed under tiled surfaces in wet areas shall be in accordance with ASTM C1178, C1278, C1288, or C1325.
- 23 TRIM AND ACCESSORIES
- A. Non-Ceramic Trim: Finish as selected by Architect, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Locations and Trims:
 - a. Floor Transition, Same-Height: Schluter SCHIENE.
 - b. Floor Transition, Sloped: Schluter RENO-RAMP-K, RENO-TK, AND RENO-U.
 - c. End of Backsplash and Shower/Tub Tile: Schluter SCHIENE.
 - d. Shower/Tub Niche Edge: Schluter QUADDEC-K.
 - e. Floor to Wall Transition: Schluter DILEX-HKS.
 2. Finish: Stainless steel. Verify additional finish options with Architect.
 3. Manufacturers:
 - a. Schluter-Systems
 - b. Substitutions: See Section 016000 - Product Requirements.
- 24 SETTING MATERIALS
- A. Manufacturers:
1. Basis of Design: Custom Building Products
 2. Other Acceptable Manufacturers:
 - a. ARDEX Engineered Cements
 - b. Bostik Inc
 - c. LATICRETE International, Inc

- d. Merkrete, by Parex USA, Inc
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
- 1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 - 2. Products:
 - a. Basis of Design: Custom Building Products
 - 1) Interior Locations: Custom Building Products: ProLite Thin Set Mortar.
 - 2) Exterior Locations: Custom Building Products: MegaLite Rapid Setting Thin Set Mortar or MegaLite Thin Set Mortar (if Rapid Setting is not feasible).

25 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
- 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8-inch-wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. Basis of Design: Custom Building Products; Prism Ultimate Performance Cementitious Grout
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
- 1. Applications: Where indicated for stain and chemical resistance and ease of sanitary maintenance.
 - a. Only as indicated on drawings or as verified with Architect.
 - 2. Use standard epoxy grout for areas noted. Use industrial grade epoxy as noted in areas requiring increase chemical resistance.
 - a. Verify with Architect.
 - 3. Color(s): As indicated on drawings or as selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. Standard Epoxy Grout, Basis of Design: Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout
 - b. Industrial Grade Epoxy Grout, Basis of Design: Custom Building Products; CEG IG Industrial Grade Commercial Epoxy Grout

26 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, ASTM C920 rated silicone sealant; moisture and mildew resistant type.
- 1. Applications: At all TCNA EJ171 movement joint conditions and plumbing fixtures. Follow ASTM C1193 for proper movement joint construction.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. Basis of Design; Custom Building Products; 100% Silicone Sealant

- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based, premium grade, penetrating sealer that will not change the color or finish of the cementitious grout.
- 27 ACCESSORY MATERIALS
- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Application: Concrete floors and where indicated on drawings.
 - 2. Purpose: Designed for protecting finished tile work from existing and future concrete cracking and for “relocating” saw-cut control joints to the next nearest grout joint(s) per TCNA Method F125 Full Coverage.
 - 3. Crack Resistance: No failure at 1/8-inch gap, minimum.
 - 4. Peel-and-Stick Sheet Type:
 - a. Thickness: 40 mils, maximum.
 - b. Products:
 - 1) Basis of Design; Custom Building Products: CrackBuster Pro Crack Isolation Membrane.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - B. Waterproofing Membrane at Showers, Tubs, and Wet Floor Areas: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Verify with Architect.
 - 2. Crack Resistance: No failure at 1/16-inch gap, minimum; comply with ANSI A118.12.
 - 3. Fluid or Trowel Applied Type:
 - 4. Material: Elastomeric.
 - 5. Thickness: 25 mils, minimum, dry film thickness.
 - 6. Products:
 - a. Basis of Design: Custom Building Products: RedGard.
 - C. Sound Control Underlayment at Floors: Polypropylene type.
 - 1. As indicated on drawings or as verified with Architect.
 - 2. Material: Polypropylene spheres bonded together with polyurethane adhesive.
 - 3. Thickness: 5mm.
 - 4. Products:
 - a. Basis of Design: Custom Building Products: Easy Mat Sound Reduction Membrane.
 - b. Substitutions: Section 016000 - Product Requirements.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
 - D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 090561.
 - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 3. Follow moisture and alkalinity remediation procedures in Section 090561.
 - E. Verify that required floor-mounted utilities are in correct location.
 - F. Review and assure that substrates to be tiled are in accordance with ANSI and TCNA standards and installation materials manufacturer's installation instructions.
 - G. Report to the Architect any conditions not in compliance with standards.
 - H. Installation materials manufacturer's representative required to confirm that conditions are in compliance with manufacturers Full System Warranty.
- 32 PREPARATION
- A. Protect surrounding work from damage.
 - B. Vacuum clean surfaces and damp clean.
 - C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
 - D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
 - E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
- 33 INSTALLATION - GENERAL
- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
 - c. Tile floors consisting of rib-backed tiles.
 - d. Provide 95 percent mortar coverage at all other conditions indicated by the above standards, documents, and instructions.
 - B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
 - C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align wall joints.
 - D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
 - 1. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

- a. Ceramic Mosaic Tile: 1/16 inch.
 - b. Glazed Wall Tile: 1/8 inch.
 - c. Porcelain Tile: 1/4 inch.
- E. Form internal angles square and external angles bullnosed.
 - F. Install ceramic and/or non-ceramic trim in accordance with manufacturer's instructions.
 - G. Sound tile after setting. Replace hollow sounding units.
 - H. Keep control and expansion joints free of mortar, grout, and adhesive.
 - I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
 - J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
 - K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
 - L. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

34 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
 - 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
 - 3. Where furan bond coat and grout are indicated, install in accordance with TCNA (HB) Method F133.
 - 4. "Relocate" saw-cut control joints to the next nearest grout joint(s).
 - 5. Use cementitious grout, unless otherwise indicated.
- B. Over interior, wet and limited wet areas, on and above ground concrete substrates, install tile in accordance with TCNA Method F122 using Waterproofing Membrane.
 - 1. These are to be waterproofed areas. Waterproofing membrane shall tie into all drain flanges and flash up perimeter walls and in-field interruptions including columns, wing walls and chases to contain water in case of a flooding condition.
 - 2. Honor all concrete joints in finished tile work.
 - 3. Saw-cut control joints may be "relocated" follow TCNA Method F125 Partial Coverage with Crack Isolation Membrane over waterproofing membrane.
 - 4. Use standard epoxy grout, unless otherwise indicated.
 - a. Only as indicated on drawings or as verified with Architect.
- C. Over interior, on and above ground concrete substrates where increased chemical resistance is required, install tile in accordance with TCNA Method F133 using Industrial Grade epoxy mortar and grout and Full Coverage Crack Isolation Membrane.
 - 1. Honor all concrete joints in finished tile work.

2. Saw-cut control joints may be “relocated” to the next nearest grout joint.
 3. Use Industrial Grade Epoxy Mortar and Grout, unless otherwise indicated.
 - a. Only as indicated on drawings or as verified with Architect.
 - D. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.
- 11 INSTALLATION - WALL TILE
 - A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
 - B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin- set with dry-set or latex-Portland cement bond coat.
- 12 CLEANING
 - A. Clean tile and grout surfaces.
- 13 PROTECTION
 - A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 5123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes

1. Acoustical panels and exposed suspension systems for interior ceilings.

B. Related Requirements:

1. Division 21 - Fire Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
2. Division 23 - Air Outlets and Inlets: Air devices in ceiling.
3. Division 26 - Interior Lighting: Light fixtures in ceiling system.
4. Division 27 - Communications: Speakers in ceiling system.
5. Division 28 - Fire Detection and Alarm: Fire alarm components in ceiling system.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 REFERENCES

A. Reference Standards

1. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
2. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
3. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
4. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.
5. ITS (DIR) - Directory of Listed Products current edition.
6. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension-system members.
 2. Structural members to which suspension systems will be attached.
 3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 5. Size and location of initial access modules for acoustical panels.
 6. Items penetrating finished ceiling and ceiling-mounted items including Lighting fixtures, Diffusers, Grilles, Speakers, Sprinklers, Access panels, and Perimeter moldings.
 7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
- D. Qualification Data: For testing agency.
- E. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For finishes to include in maintenance manuals.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to Project site in manufacturer's original, unopened containers with contents clearly identified.
- B. Store materials in clean, dry, fully enclosed location, and protect against damage by surface contamination, water, excessive moisture and direct sunlight. Leave in unopened containers until ready for installation.
- C. Handling:
1. Handle metal suspension system carefully to prevent warping, twisting, and bending of members. Remove and replace members having damaged or abraded paint finish.
 2. Handle acoustical ceiling panels carefully to prevent breaking corners and edges and to prevent soiling exposed surfaces.
- 1.7 FIELD CONDITIONS
- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is

complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Verify with Interiors Finish Schedule on drawings.
- B. Acoustic Tiles/Panels:
 - 1. (Basis of Design) Armstrong World Industries, Inc.
 - 2. Acoustic Ceiling Products.
 - 3. CertainTeed Corporation: www.certainteed.com.
 - 4. USG Corporation.
- C. Suspension Systems:
 - 1. Same as for acoustical units.
- D. Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Trade names of Armstrong World Industries, Inc. are named herein to establish quality and design standards for acoustical ceiling panels. Other acceptable manufacturers:
 - 1. CertainTeed. Corporation
 - 2. USG Interiors, Inc.
- B. ACT-1:
 - 1. Basis-of-Design: Armstrong World Industries, Inc.; "Ultima No. 1912".
 - 2. Classification: Provide panels as follows:
 - a. Type and Form: Type IV, Mineral fiber with acoustically transparent membrane.
 - 3. Thickness: 5/8 inch.
 - 4. Surface Texture: Fine Texture

5. Color: White
6. Size: 24 in x 24 in,
7. Edge Profile: Square Lay-in
8. Noise Reduction Coefficient (NRC) ASTM C 423 Classified 0.75
9. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified 35
10. Light Reflectance (LR) White Panel: ASTM E 1477; 0.88
11. Recycle Content: Up to 87% total recycled content.
12. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
13. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)

C. ACT-2:

1. Basis-of-Design: Armstrong World Industries, Inc.; "Clean Room FL No. 1715".
2. Classification: Provide panels as follows:
 - a. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted.
3. Thickness: 3/4 inch.
4. Surface Texture: Smooth
5. Color: White with Gray Spatter
6. Size: 24" x 24"
7. Edge Profile: Square Lay-In 15/16
8. Noise Reduction Coefficient(NRC): ASTM C 423; Not less than 0.70
9. Ceiling Attenuation Class (CAC) : ASTM C 1414; Not less than 35.
10. Flame Spread: ASTM E 1264; Class A (UL)
11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.79
12. Recycle Content: Post-Consumer - 0% Pre-Consumer - 76%
13. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
14. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)

- D. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension System: Trade names of Armstrong World Industries "Prelude XL" Exposed Tee Suspension System are named herein to establish quality and design standards for metal suspension systems. Other Acceptable Manufacturers:
1. USG Interiors Inc.
 2. CertainTeed Corporation.
 3. Chicago Metallic.
- B. Exposed Grid: ASTM C635, intermediate duty, components formed from roll formed cold rolled steel electrozinc coated or manufacturer's standard coating complying with ASTM C635; white; 2'-0" x 2'-0" module.
1. Nonrated System: "Prelude XL" Series
 - a. Main Tees: "Prelude 7300 Series".
 - b. Cross Tees: "Prelude XL 7342" Series.
 - 1) 1-1/2 inch web height and 15/16-inch exposed flange width.

- 2) Double web design with rectangular bulb integral ends for splicing end-to-end.
 - c. Spline: "Prelude XL 7328" for 2-foot x 2-foot panels.
 - d. Other Acceptable Systems:
 - 1) USG Interiors "Donn DX" Series.
 - 2) Chicago Metallic "1200 System".
 - 3) CertainTeed Corporation "Classic Stab System".
- C. Drywall Suspension System (**LINC**)
1. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with wall angles and moldings, curtain pockets, and splices as required.
 2. Materials: Steel Grid: ASTM A653/A653M G40 coating, unless otherwise indicated.
 - a. Exposed Suspension System: Hot-dipped galvanized steel grid and cap; factory-applied closed-cell foam gaskets.
 - b. Application(s): As indicated by the Architectural Drawings
 - c. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 - d. Recycled Materials Content: Classified as containing greater than 50 percent total recycled content.
 - e. Profile: Tee; 1-1/2 inch (38 mm) face width.
 - f. Finish: Baked enamel.
 - g. Color: As indicated on drawings.
 3. Products:
 - a. USG Corporation; DGLW 1-1/2-inch Heavy Duty Concealed Suspension System: www.usg.com/ceilings.
 - b. Substitutions: Not permitted.
 4. Moldings and Trim:
 - a. Edge Molding, Expansion Joints, and Splices - General: Same material, thickness, and finish as metal pan panels, unless otherwise indicated.
 - b. Perimeter Wall Moldings: Same metal and finish as grid.
 - c. Size: As required for installation conditions.
 - d. Angle Moldings: L-shaped, for mounting at same elevation as face of grid.
 - e. Shadow Moldings: Shaped to create a perimeter reveal.
 - f. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
 5. Acoustical Sealant For Perimeter Moldings: Nonhardening, nonskinning, for use in conjunction with suspended ceiling system.
- D. Edge Molding: Armstrong Molding "7874 Series"; minimum 0.020-inch thick steel; minimum 7/8-inch flange width; hemmed edge.
- E. Bullnosed Corner: Armstrong "7864" Bullnose Corner Cover.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Wire Hangers, Braces, and Ties: Provide wires as follows:

2. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 3. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
- B. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
1. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
 2. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
7. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096516 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS

- ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
- ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
- ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
- ASTM F 1700 Standard Specification for Solid Vinyl Tile
- ASTM F 1861 Standard Specification for Resilient Wall Base
- ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- ASTM F 1913 Standard Specification for Sheet Vinyl Floor Covering without Backing
- ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
- NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

1.4 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation, and maintenance instructions (latest edition of Armstrong Flooring Guaranteed Installation Systems instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- D. Submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- E. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals

(Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

2. Warranty: Warranty documents specified herein.

15 VOC CONTENT RESTRICTIONS

- A. Flooring and adhesives shall not exceed reference standards limits for VOC content.

16 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- B. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.
- C. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

17 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

18 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

21 RESILIENT TILE FLOORING

- A. **TYPE LVT 1, LVT 2** - Laminated Vinyl Tile: A layered construction consisting of a clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a UV-cured polyurethane finish. Colors are insoluble in water and resistant to cleaning agents and light.
 1. Manufacturers, Products, and Color: Refer to Architectural drawings for product selections and additional resilient flooring information.
 2. Minimum Requirements: ASTM F 1700, "Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
 3. Pattern Size and Color: in color selected from the range currently available from manufacturers standard products.

4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
5. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
6. Wear layer thickness: 0.020 in. (0.5 mm).
7. Total Thickness: 0.006 inch, or as otherwise indicated on drawings.

B. **TYPE RSF-1, RSF-2** - Homogeneous Sheet Flooring: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a diamond-infused UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.

1. Manufacturers, Products, and Color: Refer to Architectural drawings for product selections and additional resilient flooring information.
2. Minimum Requirements: Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Sheet Floor Covering Without Backing
3. Pattern Size, and Color: in color selected from the range currently available from manufacturers standard products.
4. Width: 6 ft. 5 in. (1.98 m).
5. Length: up to 65.62 ft. (20 m)
6. Thickness: 0.080 in. (2.0 mm)

C. Weld Rod:

1. Provide solid color vinyl weld rod as produced by AHF Products and intended for heat welding of seams. Color shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring. Color selected from the range currently available from AHF Products]

D. Seam Adhesive:

1. Provide Armstrong Flooring S-761 Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

E. **(RBS-1)** Wall Base: FS SS-W-40, Type I, rubber, coved base, 6 - inches high x 1/8-inch thick, including pre-molded end stops; continuous, by one of following. Refer to Finish Schedule on Drawings for selections and installation locations.

1. Armstrong World Industries.
2. Patcraft Corporation
3. Roppe Corporation.

22 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Vinyl.

1. Manufacturers:
 - a. Roppe Corp: www.roppe.com.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION**31 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 09 0561.
 - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

32 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

33 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

34 INSTALLATION - SOUND CONTROL UNDERLAYMENT

- A. Install in accordance with underlayment manufacturer's instructions.

35 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install tile to pattern indicated on drawings. Allow 1/2 full size tile width at room or area perimeter.

36 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and wax in accordance with manufacturer's written instructions.

37 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carpet tile, fully adhered.

B. Related Requirements:

1. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap and removed carpet tile.
2. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.2 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016 (Reapproved 2021).
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2021.
- C. CRI 104 - Standard for Installation of Commercial Carpet 2015.

1.3 ACTION SUBMITTALS

A. General: In compliance with Section 01 33 00 and as specified herein.

B. Product Data: For each type of carpet material, and installation accessory specified. Submit Manufacturer's printed data on physical characteristics, durability, fade resistance, and fire-test-response characteristics. Submit methods of installation for each type of substrate.

1. If carpet manufacturer does not publish detailed installation data, installer must provide detailed
2. proposed procedures for Architect's approval.
 - a. Carpet manufacturer, prior to installation, shall provide written specifications as to degree of variations expected, degree of installed mis-match (if any) considered acceptable, and all guarantees and warranties of pattern match offered.

C. Shop Drawings: For carpet tile installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.

8. Type, color, and location of insets and borders.
 9. Type, color, and location of edge, transition, and other accessory strips.
 10. Transition details to other flooring materials.
- D. Samples for Verification: Actual sample of finished products for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
- E. Product Schedule: For carpet tile, Use same designations indicated on Drawings.
- F. Sustainable Design Submittals:
1. Carpeting and adhesives shall not exceed reference standards limits for VOC content
- G. Certificate: Carpet manufacturer's certification to Architect ensuring carpet meets specifications. Submit at time of carpet delivery to Project. Certificate must be signed by authorized officer of carpet manufacturing company and contain Contractor's name and address, Project location, and quantities and date, or dates, of shipment or delivery to which certificates apply.
- H. Maintenance Data: In compliance with Section 01 77 00 and as specified herein. Include recommendations for various traffic conditions, cleaning procedures and cleaning intervals.
1. Methods for maintaining carpet, including manufacturer's recommended frequency for maintaining carpet.
 2. Include cleaning and stain-removal products and procedures and precautions for cleaning materials and methods that might be detrimental to finishes and functions.
- I. Letter of Conformance; (FIO): In compliance with requirements of, and in format included in, Section 01 33 00.
- 1.4 MAINTENANCE MATERIAL SUBMITTALS
- A. Extra Stock Material: Include 6% carpet overrun of each carpet. Furnish Architect and Owner verification of total yardage delivered by mill, showing exact amount of overrun. Deliver to Owner all carpet overrun in full rolls, properly wrapped, and labeled.
 - B. Order all materials required for complete and finished installation promptly upon receipt of signed contract or letter of intent and provide Owner and Architect with dated copies of purchase order.
 - C. Salvage scraps from installation over 3 feet square in area and over 1 foot in width for Owner's "attic stock".
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: An authorized representative who is certified by the International Certified Floorcovering Installers Association at the [Commercial II] [Master II] <Insert **description**> certification level.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original mill wrappings with register tag number attached. Deliver only after building is enclosed and spaces are temperature and humidity controlled.
- B. Store materials under cover, off floor in ventilated space. Protect from damage, staining and moisture.
- C. Do not stand roll materials on end. Comply with CRI 104.
- D. Immediately upon receipt of carpet, submit samples to Architect for verification of type, pattern, and color. Identify samples with carpet name, number and manufacturing and shipping registry numbers. Inspect carpet for quantity and defects.

1.7 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
 - b. Loss of tuft-bind strength.
 - c. Excess static discharge.
 - d. Delamination.
 - e. Dimensional instability.
 - 3. Warranty Period: 10 years from date of Substantial Completion.
 - 4.
 - 5.
 - 6.
 - 7.
 - 8.
 - 9.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Carpet products shall consist of high performing, complete, systems of Forms and Materials.
 - 1. Construction: Tufted
 - 2. Tufted Face Weight: 22 oz Min.
 - 3. Flammability (ASTM E648): >.45 Class 1
 - 4. Smoke Density (NFPA 258/ASTM E662): < 450.
 - 5. Static Propensity(AATCC 134): Under 3.5 kv.

2.2 CARPET PRODUCTS

- A. Carpet products listed have been approved by Architect. Unless specifically stated as an approved equal, no other product substitution will be approved.
- B. Products listed are to conform to manufacturer's printed specifications which are in effect as of this date. Colors for all carpet are as listed, or as selected by Architect. All carpet and necessary overrun are to be from one dye lot, but where multiple dye lots are required, submit samples from each dye lot to Architect for written approval before installing carpet. Each dye lot to match approved sample. Rolls from each dye lot numbered and labeled by manufacturer and match end to end and side to side.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: Extruded aluminum with [mill] <Insert finish> finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes, and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- B. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- C. Metal Substrates: Clean grease, oil, soil, and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, non-staining marking device.

- H. Install pattern parallel to walls and borders.
- I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended in writing by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Remove stains with spot remover acceptable to carpet manufacturer.
- C. Immediately after cleaning, cover carpeted areas with heavy kraft paper. Maintain in place for remainder of construction period.
- D. Just prior to Date of Substantial Completion, remove protective covering and vacuum carpet. Steam clean areas if required to remove stains.
- E. Replace carpet which cannot be cleaned.

END OF SECTION

SECTION 099100 - PAINTING

PART 1 GENERAL

11 SUMMARY

A. Section Includes

1. Surface preparation.
2. Field application of paints.

B. Related Requirements

1. Section 033511 - Concrete Floor Finishes: Concrete floor surface treatments and coatings.
2. Section 055000 - Metal Fabrications: Shop-primed items.
3. Section 099600 - High-Performance Coatings.
4. Section 099723 - Concrete and Masonry Coatings: Moisture resistant elastomeric concrete and masonry coatings.
5. Division 21 - Fire Suppression: Painted identification.
6. Division 22 - Plumbing: Painted identification.
7. Division 23 - Heating, Ventilating, and Air Conditioning: Painted identification and color coding.
8. Division 32 - Exterior Improvements: Painted pavement markings.

12 REFERENCE STANDARDS

- | | |
|------------------------|---|
| 40 CFR 59, Subpart D - | National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition. |
| ASTM D16 - | Standard Terminology for Paint, Related Coatings, Materials, and Applications 2019. |
| ASTM D4258 - | Standard Practice for Surface Cleaning Concrete for Coating 2005 (Reapproved 2017). |
| ASTM D4442 - | Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020. |
| MPI (APL) - | Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition. |
| MPI (APSM) - | Master Painters Institute Architectural Painting Specification Manual Current Edition. |
| SSPC V1 (PM1) - | Good Painting Practice: Painting Manual, Volume 1 2016. |
| SSPC V2 (PM2) - | Systems and Specifications: Steel Structures Painting Manual, Volume 2 2015. |

13 ADMINISTRATIVE REQUIREMENTS

- A. Scope: Finish interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Including the following:

1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
2. Prime surfaces to receive wall coverings.
3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- B. DO NOT Paint or finish the following items.
 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 2. Items indicated to receive other finishes.
 3. Items indicated to remain unfinished.
 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 6. Marble, granite, slate, and other natural stones.
 7. Floors, unless specifically indicated.
 8. Ceramic and other tiles.
 9. Glass.
 10. Concrete masonry units in utility, mechanical, and electrical spaces, unless otherwise indicated.
 11. Acoustical materials, unless specifically indicated.
 12. Concealed pipes, ducts, and conduits.
 13. Exposed Ducts: Verify paint or finish requirement on exposed ducts in finished spaces with Architect.

14 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product. Include preparation requirements and application instructions.
 1. Include preparation requirements and application instructions.
 2. Indicate VOC content.
 - 3.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- D. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.
- E. Closeout Submittals
1. Coating Maintenance Manual: Upon completion of the Project, submit a coating maintenance manual.
 2. The manual shall include the following information:
 3. A coating finish schedule designating where each product/color/finish was used.
 4. Mix formulas for each color used.
 5. Product data pages.
 6. Material Safety Data Sheets.
 7. Care and cleaning instructions.
 8. Touch-up procedures.
 9. Color sample of each color and finish used.

15 VOC CONTENT RESTRICTIONS

- A. Paints and coatings shall comply with Green Seal's GS-11 and meet the limits for VOC content.

16 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Paint systems for all substrates to be tested and approved for adhesion quality prior to completion of painting work.
 2. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 3. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

17 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

18 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

19 WARRANTY

- A. Installer's Warranty: Should the paint peel or show any other visible signs of non-bonding or non-adhesion to the surface, the Contractor shall be required to repaint the area in which the problem has occurred at no cost to the Owner.
 1. Installer's Warranty Duration: Two years from Substantial Completion.

PART 2 PRODUCTS

21 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B. Paints:
 1. Base Manufacturer: Sherwin-Williams Company
 2. PPG Paints
 3. Benjamin Moore Paints
 4. Behr Paints
- C. Primer Sealers: Same manufacturer as topcoats.

D. Substitutions: See Section 016000 - Product Requirements.

22 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors or as indicated on drawings.
1. Selection to be made by Architect after award of contract.
 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 3. Extend colors to surface edges; colors may change at any edge as directed by Architect.

23 PAINT SYSTEMS – INTERIOR (**PNT-1 through PNT-8**)

- A. PAINT IN-01 - Wood, Opaque, Latex, 2 Coat:
1. Flat: One coat of acrylic latex enamel; S-W ProMar 400 Zero VOC Interior Latex Flat, A30 Series (4.0 mils wet, 1.2 mils dry per coat).
 2. Semi-gloss: One coat of latex enamel; S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2200 Series (4.0 mils wet, 1.6 mils dry per coat).
- B. PAINT IN-02 - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler; S-W Loxon Block Surfacer, A24W200 (50-100 sq ft/gal).
 2. Eggshell; Two coats of latex enamel; ProMar® 200 Zero VOC Interior Latex Semi-Gloss, B26-2600 Series (4 mils wet, 1.7 mils dry per coat).
- C. PAINT IN-03 - Ferrous Metals, Unprimed, Alkyd, 2 Coat:
1. One coat of alkyd primer; S-W Kem Kromik Universal Metal Primer (VOC Complying) B50 Series (minimum 3.2 mils dry).
 2. Gloss: One coat of alkyd enamel; S-W Industrial Enamel B54 Series (minimum 2.0 mils dry).

- D. PAINT IN-04 - Galvanized Metals, Alkyd, 2 Coat:
1. One coat galvanize primer.
 2. Gloss: One coat of alkyd enamel; S-W Industrial Enamel B54 Series (minimum 2.0 mils dry).
- E. PAINT IN-05 - Gypsum Board/Plaster, Latex, 3 Coat:
1. One coat of latex primer sealer; S-W Multi-Purpose Interior/Exterior Latex Primer/Sealer, B51-450 Series (4.0 mils wet, 1.44 mils dry per coat).
 2. At fiberglass mat gypsum board (mold resistant type) provide one coat high build surfacer/primer; S-W Builders Solution Interior Latex Primer/Surfacer (8.0 -10.0 mils wet per coat).
 3. Eggshell (Where scheduled on drawings.): Two coats of latex enamel; S-W ProMar 200 Zero VOC Latex Eg-Shel, B20 Series (4.0 mils wet, 1.7 mils dry per coat).
 4. Flat (Walls, where scheduled on drawings): Two coats of latex enamel; S-W ProMar 200 Zero VOC Latex Flat, B30 Series (4.0 mils wet, 1.4 mils dry per coat).
 5. Flat (Ceilings): Two coats of acrylic latex enamel; S-W ProMar 400 Zero VOC Interior Latex Flat, A30 Series (4.0 mils wet, 1.2 mils dry per coat).

24 PAINT SYSTEMS - EXTERIOR

- A. **(BRK-1, BRK-2)** PAINT EX-01 - Masonry Surfaces, Opaque, Latex, 3 Coat:
1. One coat of primer sealer; S-W Loxon Concrete & Masonry Primer Sealer, A24W8300 (8.0 mils wet, 3.2 dry).
 2. Gloss: Two coats of latex enamel; S-W A-100 Exterior Latex Gloss, A8 (4.0 mils wet, 1.3 mils dry per coat).
 3. Gloss Early Moisture Resistant: Two coats of latex enamel, S-W Resilience Latex Gloss, K44 Series (4.0 mils wet, 1.6 mils dry per coat).
 4. Semi-gloss: Two coats of latex enamel; S-W Solo Acrylic Semi-Gloss, A76 Series (4.0 mils wet, 1.5 mils dry per coat).
 5. Satin Early Moisture Resistant: Two coats of latex enamel, S-W Resilience Latex Satin, K43 Series (4.0 mils wet, 1.52 mils dry per coat).
 6. Low Sheen: Two coats of latex enamel, S-W A-100 Exterior Latex Low Sheen, A12 Series (4.0 mils wet, 1.5 mils dry per coat).
 7. Flat Early Moisture Resistant: Two coats of latex enamel, S-W Resilience Latex Flat, K42 Series (4.0 mils wet, 1.56 mils dry per coat).
- B. PAINT EX-02 - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer; S-W Kem Kromik Universal Metal Primer (VOC Complying) B50 Series (minimum 3.2 mils dry).
 2. Gloss: Two coats of alkyd enamel; S-W Industrial Enamel B54 Series (minimum 2.0 mils dry).
- C. **(RPT-1)** PAINT EX-03 - Galvanized Metals, Latex, 2 Coat:
1. One coat galvanize primer.
 2. Semi-gloss: One coat of high performance latex enamel; S-W Solo Acrylic Semi-Gloss, A76 Series (4.0 mils wet, 1.5 mils dry per coat).

25 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

31 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Exterior Plaster and Stucco: 12 percent.
 - 2. Fiber Cement Siding: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

32 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Cover and protect storefront, door, window, and other openings.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete:
 - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
 - 3. Clean concrete according to ASTM D4258. Allow to dry.
 - 4. Prepare surface as recommended by topcoat manufacturer and according to SSPC-SP 13.

- H. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by topcoat manufacturer.
 - 3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.
 - I. Fiber Cement Siding: Remove dirt, dust, and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - J. Exterior Gypsum Board: Fill minor defects with exterior filler compound. Spot prime defects after repair.
 - K. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 - L. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
 - M. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
 - N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
- 33 APPLICATION
- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
 - C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
 - D. Apply each coat to uniform appearance.
 - E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
 - F. Sand metal surfaces lightly between coats to achieve required finish.
 - G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

34 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

35 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

36 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

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SECTION 101423 INTERIOR SIGNAGE**PART 1 - GENERAL****1.1 REFERENCE STANDARDS**

- A. Comply with all provisions, codes and regulations of the American with Disabilities Act and ANSI

1.2 SUBMITTALS

- A. General: In compliance with Section 013300 and as specified herein.
- B. Shop Drawings and Product Data:
 - 1. Include lettering styles, letter sizes and spacings, materials, thicknesses, finishes and complete installation details.
 - 2. Provide listing of installation locations and overall dimensions of each sign.
 - 3. Manufacturer's up-to-date, full range of colors, letter sizes and finishes available.
 - 4. Manufacturer's ADA contrast analysis chart.
 - 5. Owner to review and approve Shop Drawings and samples.
- C. Samples: Full size sample of type, style and colors selected, including method of attachment.
- D. Letter of Conformance; (FIO): In compliance with requirements of, and in format included in, Section 013300.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Package signs separately or in like groups of names, labeled as to names enclosed. Include installation template, hardware, or adhesive specified and installation instructions.
- B. Deliver sign systems in manufacturer's packages; identified by sign types.
- C. Deliver signs for interior installation only after building is enclosed and designated areas are ready to receive work.

PART 2 – PRODUCTS**2.1 GENERAL**

- A. Additional temporary signage required by authorities having jurisdiction (AHJ) to facilitate phased turnover or TCO conditions shall be the responsibility of the Contractor.
- B. Accessibility Compliance: Signs are required to comply with ADA Standards, ICC A117.1 and applicable North Carolina building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

2.2 SIGNS - Provide signage for all rooms as required by the North Carolina Building Code.

- A. Type A - Room Number Identification Signs.
 - 1. Engraved plastic sign with non-glare surface, minimum 1/8-inch thick x 1-1/2 inch high x length to allow for a maximum of five 3/4-inch digits, one letter and two decimal points.
 - 2. Letter style: Helvetica Condensed.
 - 3. Locations: Mechanical, Electrical, Data and Custodial Rooms.

4. Mounting: Mount on door frame.
 5. Color: Dark brown with white characters.
 6. Braille is not required.
- B. Type B - Room Number and Name Identification Signs.
1. Room Number Signs: Plastic engraved sign with non-glare surface minimum 1/8-inch thick x approximately 2-1/2 inches high x length to allow for a maximum of five 3/4-inch raised digits, one letter and two decimal points, with room number at top and Braille below on the same sign. Provide room number signs at each end of each corridor, at each side of communicating doors, and at entry into all rooms or spaces.
 2. Room Identification Signs: Plastic sign with non-glare surface, minimum 1/8-inch thick x approximately 2-1/2 inches high x length to allow for wording and using 1-inch high raised lettering with braille. Architect to provide location. Provide raised lettering. Provide one sign each with the wording for each space as indicated by the Architectural drawings or required by the Authority Having Jurisdiction. Architect to indicate location.
 3. Letter Style: Helvetica Condensed.
 4. Mounting: Install on wall at 60-inches above finished floor to centerline, 2-inches from latch edge of door frame or opening where allowed by code or ADA requirements. Install underneath the room number sign.
 5. Color: Dark Brown with white characters. Blue with white characters for MEN and WOMEN.
 6. Braille is required. Lettering, braille, and symbols shall be formed using a “sand blasting” or Sand Carving method. No surface applied or chemically welded letters.
- C. Type C - Electrical, Mechanical and Sprinkler Riser Rooms and Stairs:
1. Engraved plastic signs with non-glare surface, minimum 1/8-inch thick x 3-inches high x length to allow for at each electrical room to read “ELECTRICAL” and at sprinkler riser rooms to read “SPRINKLER RISER”. Letters to be 1-3/4 inches high.
 2. Letter Style: Helvetica condensed.
 3. Locations: Electrical and Sprinkler Riser Rooms.
 4. Mounting: Install on face of door centered at 60-inches above finished floor to center line.
 5. Color: Red with white characters.
 6. Braille is not required.
 7. Provide signage for each Exit Stair to include international symbol, wording “STAIR” “FIRE EXIT” and room number. Signage to have 1-inch high letters with braille. Color is dark brown with white characters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify surfaces are ready to receive signs.
- B. Beginning installation means installer accepts existing surfaces and conditions.

3.2 INSTALLATION

- A. Install signs in compliance with selected manufacturer's instructions and ADA.
- B. Install signs level, plumb, and true-to-line.
- C. Install signs after doors and surfaces are painted and finished.

- D. Install all signs with silastic adhesive or double-sided vinyl tape and two vandal proof, stainless steel counter sunk screws with finish to match signs. Install with drilled inserts at CMU walls and toggle bolts at drywall partitions. Silicone rubber sealant shall not be used as an adhesive.

- E. Install metal letters at food court with stud mounting as indicated on Drawings.

END OF SECTION

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SECTION 102800 - TOILET ACCESSORIES**PART 1 - GENERAL****1.1 SUBMITTALS**

- A. General: In compliance with Section 013300 and as specified herein.
- B. Product Data:
 - 1. Complete schedule and brochures containing catalog cuts and technical data for each individual item.
 - 2. Mark out all nonapplicable data.
- C. Samples:
 - 1. Furnish samples of each item, when requested by Architect.
 - 2. Approved samples will be returned and may be incorporated into Project.
 - 3. Identify installed samples.
- D. Letter of Conformance; (FIO): In compliance with requirements of, and in format included in, Section 013300.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver accessories to Project site until rooms are ready to receive them.
- B. Pack accessories individually in manner to protect accessory and its finish.

PART 2 - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Acceptable Manufacturers: All accessories product of manufacturer as listed:
 - 1. **NO SUBSTITUTIONS** allowed for this section without prior Architect approval.

2.2 ITEMS

- A. Finish: No. 4 satin finish, vertical grain, stainless steel, unless specified otherwise.
- B. Item **SD1**; Soap Dispenser, Behavioral Safety Products (ligature resistant) SD 0750
- C. Item **PTR1**; Paper Towel Dispenser, Behavioral Safety Products (ligature resistant) PH 235
- D. Item **TT1**; Toilet Paper Holder, recessed Whitehall Manufacturing "Best Care" WH1845B.
- E. Item **Grab Bars** (Handicapped Compartments): 18-8, Type-304, 18-gauge stainless steel tubing with a satin-finish, slip-resistant surface. 1-1/4" outside diameter. Ends are heliarc welded to concealed mounting flanges. Clearance between the grab bar and wall is 1-1/2". Concealed Mounting Flanges - 18-8, Type-304, 11-gauge thick, stainless steel plate; end flanges 2" x 3-1/8" with holes for attachment to wall. Intermediate flanges 2-5/8" x 3-1/8" wide x 3-1/8" diameter; peened nonslip gripping surface.
 - 1. Sizes: 18 inches (vertical) at the side of the water closet, 36-inches (horizontal) on the wall at the rear of the water closet and 42-inches (horizontal) at the side of the water closet.

2. Attachment: 1/4-inch diameter stainless steel thru-bolts with minimum 10 gauge stainless steel backup plate; except expansion bolts into grouted cell unit masonry where rear side of wall is exposed to finished public space.
 3. Clearance: 1-1/2 inch between wall and bar.
 4. Manufacturer and Model:
 - a. **GB18/36/42-1**: Securing Cosmos 811-S03 "SafeSupport" SR Grab Bar with self draining ends.
 - b. **GB18/36/42-2**: Bobrick B5806.99 (peened) Series.
- G. Item **MM1**; Mirrors, 2 1/2" wide hardwood frame. Type 304 20 gauge polished stainless steel plate mirror, polished to a #8 finish, with 3/8" medium density fiberboard backer. Secured by 3 countersunk pin-head 'Torx' fasteners (12 total) to continuous wood blocking and filed with glue-in matching wooden plugs.
- 1 Behavioral Safety Products. FM 160 HF
- H. Item **MM2**; Mirrors, 18" x 36" - Single piece, roll-formed 3/4" x 3/4" angle-frame. Type 304 stainless steel angle with satin finish. Corners heliarc welded, ground and polished smooth. Beveled frame edge at mirror 1/4" glass mirror; warranted against silver spoilage for at least 15 years. Galvanized steel back. Secured to concealed wall hanger with theft-resistant mounting.
- 1 Bobrick B-290 1836 Series Mirror
- I. *Item T8; Under Lavatory/Sink Pipe Insulation: Truebro Manufacturing Co. "101W or 102W", Brocar-Products, Inc. "Trap Wrap Series 500, or Plumberex Specialty Products, "Handy Shield Safety Covers"; at each lavatory. Provide all accessories necessary to wrap all piping to fixture and/or wall.*
- J. Item **SCR**: Shower Curtain Rod, 1" (25mm) diameter rod is 20-gauge, type 304 stainless steel, satin finish. 1 3/8" diameter flanges are chrome-plated plastic, bright-polished finish; mount on concealed wall brackets.
- K. Item **SC**: Shower Curtain, 70" W x 72" H, Opaque, matte white vinyl, .008" thick, contains antibacterial and flame retardant agents. White HDPE grommets along top, one every 6". Hemmed bottom and sides, requires 12 hooks to be included.
- L. Mop and Broom Holder: Surface mounted 3'-0" long mop and broom holder with 4 mop holders, 3 rag hooks, and 8-inch deep shelf.
- 1 Bobrick "#B-224".
 - 2 Bradley 9984".
 - 3 McKinney/Parker "#224/232".

1.2 FABRICATION

- A. Cabinet Construction: Constructed of ASTM A167, Type 302/304 stainless steel, minimum 22 gauge, except doors of flush face cabinets minimum 18 gauge.
- 1 Unit Construction: Seamless or welded, all welds ground smooth prior to finishing on exposed surfaces. Full, continuous backs and sides. Flush face units seamless construction.
 - 2 Hinges: Continuous stainless steel piano hinges.
 - 3 Stops: Spring or cable stops located inside cabinet to limit opening to 120 degrees maximum.
 - 4 Bumpers: Rubber bumpers to cushion door closing.
 - 5 Exposed Edges: Hemmed, returned or flanged; sharp edges not allowable.
- B. Provide steel anchor plates and anchor components for installation on building finishes.
- C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

- D. Back paint components with bituminous paint where contact is made with building finishes to prevent electrolysis.
- E. Hot-dip galvanize ferrous metal anchors and fastening devices.
- F. Shop assemble components and package complete with anchors and fittings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Size rough openings for recessed accessories. Provide wood blocking and grounds necessary for proper anchorage.
- B. Furnish concealed anchor plates to be built into stud walls.
- C. Furnish proper location and size of opening required for partition mounted items to toilet compartment manufacturer.
- D. Furnish locations for grab bar concealed anchor plates to be built into walls.

3.2 INSTALLATION

- A. Install accessories in compliance with manufacturer's recommendations, unless indicated otherwise.
- B. Install accessories true, plumb and level, to fit snug and tight against wall surface at heights indicated in Drawings.
 - 1. Use concealed fasteners wherever possible.
 - 2. Use tamper-proof bolts and screws for exposed fasteners.
- C. Provide key locked accessories keyed alike.
- D. Ceiling channel track for Clinic curtain is to be hung from building structure.

END OF SECTION 102800

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SECTION 102819 - TUB AND SHOWER ENCLOSURES

PART 1 GENERAL

11 SECTION INCLUDES

- A. Frameless tub and shower enclosures.

12 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2020a.
- G. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing 2021.
- H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar 2015.
- I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

13 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's literature for enclosure.
- C. Shop Drawings: Indicate layout, dimensions, identification of components, and interface with adjacent construction.
- D. Selection Samples: Two sets, representing manufacturer's full range of available metal, glass, and cast polymer materials and finishes.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Specimen Warranty.

14 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

15 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

16 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one-year period after Date of Substantial Completion.
- C. Provide five-year manufacturer warranty against structural failure and excessive degradation of metal finishes.

PART 2 PRODUCTS

21 MANUFACTURERS

- A. Shower Enclosures:
 - 1. Basis of Design: Clarion Bath Products, Cast Acrylic One Piece shower insert, White.
 - a. Clarion AN6030BFSC 65x30.25 (ADA)
 - b. Clarion RE5636 36X35 (STANDARD)
 - 2. Substitutions: See Section 016000 - Product Requirements.

22 SHOWER ENCLOSURES - GENERAL

- A. Exposed Fittings and Hardware: Aluminum.
- B. Premium Cast Acrylic
- C. Slip resistant floor
- D. Reinforced walls
- E. Center drain
- F. Molded soap ledges
- G. Shower Doors: Kennon SSPD , Magnetic Closures, Break-Away Hinge, NO Substitutions.
- H. Ligature Resistant Shower Seat: Metcraft Industries Model A517-LR
- I. Accessorized and installed to meet requirements of ADA and ICC/ANSI A117.1-2017.
- J. Comply with all requirements for the North Carolina Building Code.
- K. Certified to meet CSA B45.5/IAPMO Z124 Standard

23 MATERIALS

- A. Fixtures: Shower Head, Shower Control Shower Diverter and ADA Wand Assembly are specified by Section 224223.
- B. Aluminum Components: Complying with ASTM B221 (ASTM B221M), alloy 6063, temper as indicated, with anodized finish complying with AAMA 611, and powder coating complying with AAMA 2603 or AAMA 2604 for select colors.
- C. Glazing Seals: Provide manufacturer's standard clear polycarbonate seal at jambs and door bottom for water-tight seal between glass and surrounding frame or construction.
- D. Sealant: One-part mildew-resistant silicone sealant, complying with ASTM C920, clear.
- E. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION**31 EXAMINATION**

- A. Do not begin installation until supports and adjacent substrates are complete.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

32 PREPARATION

- A. Clean substrates thoroughly prior to installation.
- B. Prepare substrates as recommended by the manufacturer.

33 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. Fit and align tub and shower enclosure level and plumb.

34 FIELD QUALITY CONTROL

- A. Verify enclosure does not leak while shower is running, and door is fully closed, and catch is engaged.

35 ADJUSTING

- A. Adjust tub and shower enclosure doors to operate smoothly.

36 CLEANING

- A. Remove protective film and temporary stickers from exposed metal and glass surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.
- C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.
- D. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

37 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.

38 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 104400 - FIRE PROTECTION SPECIALTIES**PART 1 GENERAL****11 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Fire extinguisher stands.
- D. Extinguisher accessories.

12 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 092116 - Gypsum Board Assemblies: Roughed-in wall openings.
- C. Section 099123 - Interior Painting: Field paint finish.
- D. Section 113100 - Residential Appliances: Kitchen ranges and range hoods.

13 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).
- C. UL (DIR) - Online Certifications Directory Current Edition.

14 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

15 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Certificate: Certificate stating that installed products meet or exceed specified requirements.

16 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS**21 MANUFACTURERS**

- A. Fire Extinguishers:
 - 1. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 2. Nystrom, Inc: www.nystrom.com.
 - 3. Potter-Roemer: www.potterroemer.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories: Basis of design - Larsen's "Architectural 2712 Series". All recessed steel cabinets to have a heavy gauge, white baked enamel box. Cabinets with stainless steel door and trim have a box constructed entirely of 304 stainless steel with a #4 finish. Stainless steel cabinets have a full ½" thick hollow metal heavy gauge door. Trims and doors feature one piece construction with satin finish pull handle, continuous matching hinge, and self-adjusting roller catch. Baked white enamel finish is standard for steel units. Other allowable manufacturers include:
 - 1. Nystrom, Inc: www.nystrom.com.
 - 2. Potter-Roemer: www.potterroemer.com.
 - 3. Substitutions: See Section 016000 - Product Requirements.

22 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. UL Rating: 4A-60B:C.
 - 3. Size: 10 pound.
 - 4. Finish: Baked polyester powder coat, color as selected.
 - 5. Temperature range: Minus 65 degrees F to 120 degrees F.

23 FIRE EXTINGUISHER CABINETS AND STANDS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 - 1. Formed primed steel sheet; .050 inch thick base metal.
- C. Fire Rated Cabinet Construction: Rating as indicated on drawings.
 - 1. Steel; double wall with 5/8 inch thick fire barrier material, or as otherwise recommended by manufacturer for indicated rating.
- D. Cabinet Configuration (Interior building locations): Recessed type.
 - 1. Size to accommodate accessories.
 - 2. Door: 0.050 inch thick, reinforced for flatness and rigidity; latch. Hinge doors with full length continuous piano hinges for 180 degree opening with two butt hinge. Provide nylon catch. Provide door pull.
 - 3. Door Glazing: Glass, duo panel, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
 - 4. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - 5. Fabrication: Weld, fill, and grind components smooth.
 - 6. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
 - 7. Finish of Cabinet Interior: White colored enamel.

24 EXTINGUISHER ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.
- C. Cabinet Signage: FIRE EXTINGUISHER lettering in red pressure sensitive vinyl (PSV); lettering running horizontal. Furnish PSV lettering loose for installation after painting.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets and on wall brackets at 48" high maximum to extinguisher controls, or as otherwise required by accessibility regulations.
- D. Install charged extinguishers not more than 48 hours prior to Date of Substantial Completion.
- E. Quantities required:
 - 1. One extinguisher in each fire extinguisher cabinet.
 - 2. One extinguisher on each fire extinguisher bracket.
- F. Seal perimeter with sealant; use UL rated sealant installation for rated construction.
- G. Install cabinet signage lettering on each cabinet door after field painting.
- H. Install identification for bracket mounted extinguishers. Install decals above each extinguisher unit in accord with NFPA 10 and ADA.

END OF SECTION

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SECTION 107300 PROTECTIVE COVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Heavy duty pre-engineered, pre-finished aluminum canopy systems.

1.2 REFERENCES

- A. Current edition of the following standards
 1. AA ADM-1 - Aluminum Design Manual: Specifications & Guidelines for Aluminum Structures; The Aluminum Association, Inc.
 2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association
 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 4. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 5. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 6. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 7. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 8. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 9. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 10. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
 11. ASTM D 1735 - Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus.
 12. ASTM D 2244 - Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 13. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 14. ASTM G 87 - Standard Practice for Conducting Moist SO₂ Tests.

1.3 SYSTEM DESCRIPTION

- A. Manufactured system live load support, dead load support, and wind uplift resistance to be designed by manufacturer for project wind speed zone and prevailing building code requirements amendments. Manufacturer to verify design requirements with prevailing building code.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Manufacturer's descriptive literature for specified systems, including all components.
- C. Shop Drawings: Indicate layout heights, component connection details, and details of interface with adjacent construction.
- D. Warranty documents, issued and executed by manufacturer, countersigned by Contractor.
- E. Certificate: Certificate stating that installed products meet or exceed specified requirements.

15 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum five (5) years of documented experience producing systems of the types specified in this section.
- B. Installer Qualifications: Minimum three (3) years documented experience installing systems of the types specified in this section, and approved by manufacturer.
- C. Pre-Installation Meeting:
 - 1. Convene at job site seven (7) calendar days prior to scheduled beginning of construction activities of this section to review requirements of this section.
 - 2. Require attendance by representatives of the installer and other entities directly affecting, or affected by, construction activities of this section.
 - 3. Notify Architect four (4) calendar days in advance of scheduled meeting date.

16 DELIVERY, STORAGE, AND HANDLING

- A. Store system components in accordance with manufacturer's instructions until installation.

17 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Furnish systems manufacturer's standard warranty against defects in product workmanship and materials, including deterioration of metal finishes.

PART 2 PRODUCTS

21 MANUFACTURERS

- A. Architectural Shade Products; www.architecturalshade.com.
- B. Mapes Architectural Canopies: <https://mapescanopies.com>.
- C. Mitchell Metals; www.mitchellmetals.net.
- D. Substitutions: See Section 01600 - Product Requirements.
- E. Unless otherwise specified for an individual product or material, supply all products specified in this section from the same manufacturer.

22 CANOPY SYSTEM

- A. Basis of Design – Post Supported Canopy Type: Mapes Architectural Canopies: Super Lumideck, 8" Industrial Fascia, or as otherwise indicated on drawings: <https://mapescanopies.com>.
 - 1. Mounting Height: As indicated on drawings.
 - 2. Soffit: Flat.

3. Finish: High performance AAMA 2605 Standard finish.
4. Color: To be selected by Architect.

PART 3 EXECUTION

31 EXAMINATION

- A. Verify that project conditions are as indicated on shop drawings.
- B. Installer's Examination:
 1. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
 2. Transmit two copies of installer's report to Architect within 24 hours of receipt.
 3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
 4. Beginning construction activities of this section indicates installer's acceptance of conditions.

32 PREPARATION

- A. Ensure that adjacent surfaces, structures, and finishes are protected from damage by construction activities of this section.

33 INSTALLATION

- A. Install systems specified in accordance with shop drawings and manufacturer's installation instructions.

34 CLEANING

- A. Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.

12 PROTECTION OF INSTALLED PRODUCTS

- A. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.
- B. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.

END OF SECTION

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SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves with waterstop.
 2. Sleeve-seal systems.
 3. Grout.
 4. Silicone sealants.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 SLEEVES WITH WATERSTOP

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, LLC.
 2. CALPICO, Inc.
 3. GPT; a division of EnPRO Industries.
 4. Metraflex Company (The).
- B. Description: Manufactured PVC/HDPE steel stainless steel galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, LLC.
 2. CALPICO, Inc.
 3. GPT; a division of EnPRO Industries.
 4. Metraflex Company (The).
 5. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
 2. Sealing Elements: EPDM-rubber High-temperature-silicone Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 3. Pressure Plates: Carbon steel Composite plastic Stainless steel Stainless steel, Type 316.
 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating Stainless steel Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Permathane; a Holcim brand.
 - c. Polymeric Systems, Inc.
 - d. Sherwin-Williams Company (The).
 - e. Sika Corporation.
 - f. The Dow Chemical Company.
 - g. Tremco Incorporated.
 2. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
1. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Smooth-On.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Escutcheons.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The).
 - 5. Mid-America Fittings, LLC; A Midland Industries Company.

2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

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

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

- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Fire Main Equipment: HAMV - Main Level.
 - a. Indicator Posts, Gate Valve: HCBZ - Level 1.
 - b. Ball Valves, System Control: HLUG - Level 3.
 - c. Butterfly Valves: HLXS - Level 3.
 - d. Check Valves: HMER - Level 3.
 - e. Gate Valves: HMRZ - Level 3.
 - 2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
 - a. Valves, Trim and Drain: VQGU - Level 1.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
 - 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves
 - 3) Miscellaneous valves.
- C. NFPA Compliance for valves:
 - 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- D. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. 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. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. NIBCO INC.
3. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. 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. Globe Fire Sprinkler Corporation.
2. Milwaukee Valve Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze with EPDM coating.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

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. Anvil; an ASC Engineered Solution.
2. Globe Fire Sprinkler Corporation.
3. Kennedy Valve Company; a division of McWane, Inc.
4. NIBCO INC.
5. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
6. Victaulic Company.
7. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.5 CHECK VALVES

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. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. Anvil; an ASC Engineered Solution.
3. FEBCO; A WATTS Brand.
4. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
5. Globe Fire Sprinkler Corporation.
6. Kennedy Valve Company; a division of McWane, Inc.
7. Mueller Co. LLC; Mueller Water Products, Inc.
8. NIBCO INC.
9. Reliable Automatic Sprinkler Co., Inc. (The).
10. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
11. Victaulic Company.
12. Viking Group Inc.
13. WATTS; A Watts Water Technologies Company.
14. Zurn Industries, LLC.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. 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. Milwaukee Valve Company.
2. NIBCO INC.
3. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. 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. Kennedy Valve Company; a division of McWane, Inc.
2. Mueller Co. LLC; Mueller Water Products, Inc.
3. NIBCO INC.
4. Victaulic Company.
5. WATTS; A Watts Water Technologies Company.
6. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.

3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.8 NRS GATE VALVES

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. Kennedy Valve Company; a division of McWane, Inc.
2. Mueller Co. LLC; Mueller Water Products, Inc.
3. NIBCO INC.
4. Victaulic Company.
5. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. End Connections: Grooved.

2.9 INDICATOR POSTS

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. Kennedy Valve Company; a division of McWane, Inc.
2. Mueller Co. LLC; Mueller Water Products, Inc.
3. NIBCO INC.

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Wall Upright.
3. Base Barrel Material: Cast or ductile iron .
4. Cap: Cast or ductile iron.
5. Operation: Handwheel.

2.10 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Croker; a Division of Morris Group International.
 - c. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
 - d. Flowserve Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Potter Roemer LLC; a Division of Morris Group International.
 - h. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - i. Victaulic Company.
 - j. WATTS; A Watts Water Technologies Company.
 - k. Zurn Industries, LLC.

2. Description:
 - a. Pressure Rating: 175 psig .
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.
 - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
 - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. 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. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
 - b. NIBCO INC.
 - c. United Brass Works, Inc.

2. Description:
 - a. Pressure Rating: 175 psig .
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.

- d. Stem: Bronze.
- e. Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. NIBCO INC.
 - b. United Brass Works, Inc.
- 2. Description:
 - a. Pressure Rating: 175 psig .
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:

1. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
 2. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
 3. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.
 4. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.
 5. Section 331415 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

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SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.
- 3. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices and seismic restraints.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

- 1. Trapeze pipe hangers.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- 1. Detail fabrication and assembly of trapeze hangers.
- 2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. NFPA Compliance: Comply with NFPA 13.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 250 lb .

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- G. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- I. Insulated Piping:
 - 1. Attach clamps and spacers to piping.

- a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Comply with NFPA requirements.
- K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. C-Clamps (MSS Type 23): For structural shapes.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 210529

SECTION 211119 - FIRE-DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exposed-type fire-department connections.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- 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. Croker; a Division of Morris Group International.
 - 2. Elkhart Brass Mfg. Co., Inc.
 - 3. Guardian Fire Equipment, Inc.
 - 4. Potter Roemer.
- B. Standard: UL 405.
- C. Type: Exposed, projecting, for wall mounting.
- D. Pressure Rating: 175 psig minimum.
- E. Body Material: Corrosion-resistant metal.
- F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

- G. Caps: Brass, lugged type, with gasket and chain.
- H. Escutcheon Plate: Round, brass, wall type.
- I. Outlet: Back, with pipe threads.
- J. Number of Inlets: Two.
- K. Escutcheon Plate Marking: Similar to " STANDPIPE."
- L. Finish: Rough brass or bronze.
- M. Outlet Size: NPS 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Air vent.
3. Sprinklers.
4. Alarm devices.
5. Pressure gauges.

B. Related Requirements:

1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
2. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig .
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and NICET certified technician.
- B. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.
- C. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. Fire-hydrant flow test report.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by NICET Level III-certified technician, "Water-Based Systems Layout."

1.7 FIELD CONDITIONS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

- D. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: **<Insert test date>**.
 - b. Time: **<Insert time> [a.m.] [p.m.]**
 - c. Performed by: **<Insert operator's name> of <Insert firm>**.
 - d. Location of Residual Fire Hydrant R: **<Insert location>**.
 - e. Location of Flow Fire Hydrant F: **<Insert location>**.
 - f. Static Pressure at Residual Fire Hydrant R: **<Insert psig>**.
 - g. Measured Flow at Flow Fire Hydrant F: **<Insert gpm>**.
 - h. Residual Pressure at Residual Fire Hydrant R: **<Insert psig>**.
 - 2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 3. Sprinkler Occupancy Hazard Classifications:
 - a. **<Insert occupancy and hazard classification>**.
 - 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. As indicated on the drawings.
 - 5. Maximum protection area per sprinkler according to UL listing.
 - 6. Maximum Protection Area per Sprinkler:
 - a. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- F. Obtain documented approval of sprinkler system design from authorities having jurisdiction.
- G. Seismic Performance: Sprinkler piping to withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight Steel Pipe: Galvanized- and black-steel pipe, ASTM A53/A53M, Type E, . Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30 Steel Pipe: steel pipe, ASTM A135/A135M; ASTM A795/A795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Steel Pipe: steel pipe, ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

- D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- E. Steel Pipe Nipples: Galvanized and black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- F. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
- G. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
- H. Malleable- or Ductile-Iron Unions: UL 860.
- I. Cast-Iron Flanges: ASME 16.1, Class 125.
- J. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
 - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
 - 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. Anvil; an ASC Engineered Solution.
 - b. CPS Products, Inc.
 - c. Shurjoint; a part of Aalberts Integrated Piping Systems.
 - d. Smith-Cooper International.
 - e. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - f. Victaulic Company.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Grooved-End Fittings for Steel Piping: Galvanized Painted Uncoated grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 AIR VENT

A. Automatic Air Vent:

- 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. AGF Manufacturing, Inc.
 - b. CLA-VAL.
 - c. Engineered Corrosion Solutions.
 - d. Metraflex Company (The).
 - e. Reliable Automatic Sprinkler Co., Inc. (The).
 - f. Val-Matic Valve & Manufacturing Corp.
2. Description: Automatic air vent that automatically vents trapped air without human intervention.
 3. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler systems.
 4. Vents oxygen continuously from system.
 5. Float valve to prevent water discharge.
 6. Minimum Water Working Pressure Rating: 175 psig.

2.4 SPRINKLERS

- 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. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc. (The).
 3. Tyco Fire Products: brand of Johnson Controls International plc, Building Solutions North America.
 4. Victaulic Company.
 5. Viking Group Inc.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Sprinkler Finishes: Chrome plated bronze and painted.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
 2. Sidewall Mounting: Chrome-plated steel , one piece, flat.
- G. Sprinkler Guards:

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. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 - d. Viking Group Inc.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.5 ALARM DEVICES

A. Alarm-device types to match piping and equipment connections.

B. Electrically Operated Notification Appliances:

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. Fire-Lite Alarms; Honeywell International, Inc.
 - b. Notifier; Honeywell International, Inc.
 - c. Potter Electric Signal Company, LLC.
2. Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 6-inch minimum- diameter.
 - d. Voltage: 24 V dc.
 - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
3. Strobe/Horn:
 - a. Standard: UL 464.
 - b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
 - c. Voltage: 120 V ac, 60 Hz.
 - d. Effective Intensity: 110 cd.
 - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
 - f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor; Honeywell International, Inc.
 - c. Viking Group Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company, LLC.
 - b. System Sensor; Honeywell International, Inc.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 PRESSURE GAUGES

- 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. AGF Manufacturing, Inc.
 2. AMETEK, Inc.
 3. Ashcroft Inc.
 4. Brecco Corporation.
 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

- D. Pressure Gauge Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 331415 "Site Water Distribution Piping" for exterior piping.
- B. Install shutoff valve, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

3.3 INSTALLATION OF PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire Suppression."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire Suppression."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire Suppression."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.6 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
1. Install valves in vertical position for proper direction of flow, in main supply to system.
 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
- E. Air Vent:
1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
 3. Pipe from outlet of air vent to drain.

3.7 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves .

3.11 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers Pendent, recessed, flush, and concealed sprinklers as indicated.
 3. Wall Mounting: Sidewall sprinklers.
 4. Special Applications: Institutional space sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves with waterstop.
 2. Grout.
 3. Silicone sealants.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITH WATERSTOP

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, LLC.
 2. Metraflex Company (The).
- B. Description: Manufactured PVC/HDPE steel stainless steel galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.2 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Permthane; a Holcim brand.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.
 2. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- C. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal the space around outside of sleeves.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.4 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 220517

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SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Keeney Manufacturing Company (The).

2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; and hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Insulated Piping: One-piece steel with finish.
 - b. Insulated Piping: One-piece cast brass with finish.
 - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with finish.
 - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with finish.
 - h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with finish.
 - i. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed exposed-rivet hinge with polished, chrome-plated finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or hinge with polished, chrome-plated finish.

- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

END OF SECTION 220518

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SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermometers, liquid in glass, lead free.
2. Thermowells, lead free.
3. Pressure gauges, dial type, lead free.

B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.
2. Section 221513 "General-Service Compressed-Air Piping" for compressed air gauges.
3. Section 331415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Thermometers, liquid in glass, lead free.
2. Thermowells, lead free.
3. Pressure gauges, dial type, lead free.

B. Product Data Submittals: For each type of product.

1.3 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A. All items in this Section in contact with water for human consumption, are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 THERMOMETERS, LIQUID IN GLASS, LEAD FREE

A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Terice, H. O. Co.
2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
3. Standard: ASME B40.200.
4. Case: Cast aluminum ; 6-inch nominal size.
5. Case Form: Straight unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury-free.
7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F and deg C.
8. Window: Glass or plastic.
9. Stem: Aluminum or lead-free brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

2.3 THERMOWELLS, LEAD FREE

A. Thermowells, Lead Free:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Lead-free copper .
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
6. Internal Threads: Size and thread type as required to match thermometer mounting threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length to extend one-third of pipe diameter to center of pipe .
9. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond the finished insulation surface.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
11. Heat-Transfer Medium: Mixture of graphite and glycerin .

2.4 PRESSURE GAUGES, DIAL TYPE, LEAD FREE

A. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Trerice, H. O. Co.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Weiss Instruments, Inc.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Sealed Solid-front, pressure-relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass or plastic .
11. Ring: Brass .

B. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Plastic Case:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Trerice, H. O. Co.
 - c. Weiss Instruments, Inc.
 - d. Weksler Glass Thermometer Corp.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, plastic-case pressure gauges from a single manufacturer.
3. Standard: ASME B40.100.
4. Case: Sealed type; plastic ; 4-1/2-inch 6-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
9. Pointer: Dark-colored metal.
10. Window: Glass or acrylic plastic .

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermometer with thermowell at each required thermometer location.

- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- I. Install remote-mounted pressure gauges on panel.
- J. Install valve and snubber in piping for each pressure gauge for fluids.
- K. Install thermometers in the following locations:
 - 1. Outlet side of hot-water-balancing valve.
 - 2. Each main hot-water-recirculating line return pipe.

3.2 CONNECTIONS

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

3.3 ADJUSTING

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

3.4 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

END OF SECTION 220519

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Bronze ball valves.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

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

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

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B16.5 for flanges on steel valves.
- 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 5. ASME B16.18 for cast copper solder-joint connections.
- 6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
- 7. ASME B16.34 for flanged and threaded end connections
- 8. ASME B31.9 for building services piping valves.

- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

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

- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

- F. Valve Actuator Type:

- 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
- 2. Hand Lever: For quarter-turn valves smaller than NPS 4 .

- G. Valves in Insulated Piping:

- 1. Provide 2-inch extended neck stems.
- 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
- 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS; A Watts Water Technologies Company.
2. Standard: MSS SP-110; MSS SP-145.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded or soldered.
7. Seats: PTFE.
8. Stem: Bronze or brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
3. CWP Rating: Minimum 200 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Press.
7. Press-End Connections Rating: Minimum 200 psig.
8. Seats: PTFE or RTPFE.
9. Stem: Bronze or brass.
10. Ball: Chrome-plated brass.
11. Port: Full.
12. O-Ring Seal: EPDM or Buna-N.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Stainless Steel Piping, NPS 2 (DN 50) and Smaller: .

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze ball valves, two piece with full port, and trim. Provide with threaded or solder joint ends.
 - 2. Bronze ball valves, two piece with regular port, and trim.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

END OF SECTION 220523.12

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SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Bronze, lift check valves.
 2. Bronze, swing check valves.
 3. Bronze, swing check valves, press ends.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

- A. Product Data:
1. Bronze, lift check valves.
 2. Bronze, swing check valves.
 3. Bronze, swing check valves, press ends.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, press connections, and weld ends.
 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B16.5 for flanges for metric standard piping.
- 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 5. ASME B16.18 for cast-copper solder joint.
- 6. ASME B16.22 for wrought copper solder joint.
- 7. ASME B16.51 for press joint.
- 8. ASME B31.9 for building services piping valves.

- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.

- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

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

- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

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

2.3 BRONZE, LIFT CHECK VALVES

- A. Bronze, Lift Check Valves with Bronze Disc, Class 125:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.

- c. WATTS; A Watts Water Technologies Company.
 2. Standard: MSS SP-80, Type 1.
 3. CWP Rating: 200 psig.
 4. Body Design: Vertical flow.
 5. Body Material: ASTM B61 or ASTM B62, bronze.
 6. Ends: Threaded or soldered. See valve schedule articles.
 7. Disc: Bronze.
- 2.4 BRONZE, SWING CHECK VALVES
- A. Bronze, Swing Check Valves with Bronze Disc, Class 125:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Standard: MSS SP-80, Type 3.
 3. CWP Rating: 200 psig.
 4. Body Design: Horizontal flow.
 5. Body Material: ASTM B62, bronze.
 6. Ends: Threaded or soldered. See valve schedule articles.
 7. Disc: Bronze.
 - B. Bronze, Swing Check Valves with Bronze Disc, Class 150:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 2. Standard: MSS SP-80, Type 3.
 3. CWP Rating: 300 psig.
 4. Body Design: Horizontal flow.
 5. Body Material: ASTM B62, bronze.
 6. Ends: Threaded or soldered. See valve schedule articles.
 7. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- I. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze, swing check valves with bronze disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron, swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, soldered, or press-end connections.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze, swing check valves with bronze disc, Class 125 Class 150, with soldered end connections.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron, swing check valves with metal seats, Class 125 Class 250, with threaded end connections.

END OF SECTION 220523.14

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220500 "Common Work Results for Plumbing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

B. Stainless Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Framing System Installation: Metal ; arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

- G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. MSS SP-58, Type 39: Install protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. MSS SP-58, Type 40: Install protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.

- c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

3.6 PAINTING

- A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and and attachments for general service applications.
- F. Use stainless steel pipe hangers and corrosion-resistant attachments for hostile environment applications.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

- K. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use instead of building attachments where required in concrete construction.
- N. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

B. Related Requirements:

1. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical, compressed-air system piping and associated components in healthcare facilities.
2. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical surgical, healthcare laboratory, and dental vacuum system piping, waste anesthetic gas and oral evacuation system piping, and associated components in healthcare facilities.
3. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical carbon dioxide, laboratory carbon dioxide, medical helium, laboratory helium, medical nitrogen, laboratory nitrogen, medical nitrous oxide, laboratory nitrous oxide, medical oxygen, and laboratory oxygen.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Craftmark Pipe Markers.
 - c. Kolbi Pipe Marker Co.
 - d. Pipemarker.com; Brimar Industries, Inc.
2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Kolbi Pipe Marker Co.
 - c. Marking Services Inc.
 - d. Pipemarker.com; Brimar Industries, Inc.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Craftmark Pipe Markers.
 3. Kolbi Pipe Marker Co.
 4. Marking Services Inc.
 5. Pipemarket.com; Brimar Industries, Inc.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
1. Pipe size.
 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping .

2.3 STENCILS

- A. Stencils for Piping:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Craftmark Pipe Markers.
 - b. Kolbi Pipe Marker Co.
 - c. Pipemarket.com; Brimar Industries, Inc.
 2. Lettering Size: Size letters in accordance with ASME A13.1 for piping .
 3. Stencil Material: Aluminum, brass, or fiberboard.
 4. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 5. Identification Paint: Exterior, acrylic enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 6. Letter and Background Color: As indicated for specific application under Part 3.

2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Craftmark Pipe Markers.
 3. Kolbi Pipe Marker Co.
 4. Pipemarket.com; Brimar Industries, Inc.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.04-inch aluminum, 0.031-inch or minimum thickness, with predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire link chain or beaded chain .
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.

- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background .
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E , and other applicable codes and standards.

3.4 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background .
 - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background .
 - 4. Piping: White letters on a black background.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 - 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches , square .
 - b. Domestic Hot Water: 1-1/2 inches , square .
 - c. Domestic Hot-Water Return: 1-1/2 inches , square .
 - d. .
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. TAB of domestic water system.
 - 2. TAB of plumbing equipment:
 - a. Domestic hot-water in-line circulation pumps.
 - 3. Pipe-leakage test verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 60 90 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- D. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.

- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. hot-water circulating pumps are operational and proper rotation is verified.
 - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - k. Variable-frequency controllers' startup is complete and safeties are verified.
 - l. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) [] units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Domestic water in-line pumps.
 - 3. Domestic water heaters.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.
 - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.

- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
 - 1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - 2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
 - 3. Mark final settings and verify that all memory stops have been set.
 - 4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

3.8 PROCEDURES FOR WATER HEATERS

- A. Gas Water Heaters:
 - 1. Measure and record entering- and leaving-water temperatures.
 - 2. Measure and record water flow.
 - 3. Measure and record pressure drop.
 - 4. Record relief valve(s) pressure setting.
 - 5. Capacity: Calculate in Btu/h of heating output.
 - 6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
 - 7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
 - 8. Fan, motor, and motor controller operating data.

3.9 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus 10 percent or minus 5 percent . If design value is less than 10 gpm, within 10 percent.

3.10 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. Gas Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Low-fire fuel input in Btu/h.
 - e. High-fire fuel input in Btu/h.
 - f. High-temperature-limit setting in deg F.
 - g. Operating set point in Btu/h.
 - h. Heating value of fuel in Btu/h.
- E. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
1. Unit Data:

- a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water-pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump speed.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

3.12 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager .
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day .
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
- F. Prepare test and inspection reports.

END OF SECTION 220593

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size , as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ+ jacket .
 - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. **Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.**
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. **Johns Manville; a Berkshire Hathaway company.**
 - b. **Owens Corning.**
 - c. **ROCKWOOL.**
 - 2. **Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ+ jacket .**
 - 3. **Fabricated shapes in accordance with ASTM C450 and ASTM C585.**

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
 - 1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool 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. **Foster Brand; H. B. Fuller.**
 - c. **Mon-Eco Industries, Inc.**

C. 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. **Foster Brand; H. B. Fuller.**
 - c. **Mon-Eco Industries, Inc.**

2.5 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

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.
 - c. Owens Corning.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. **Manufacturers: Subject to compliance with requirements, provide products by the following:**
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. **RPR Products, Inc.**
2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

- a. Factory cut and rolled to size.
- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper 3-mil- thick, heat-bonded polyethylene and kraft paper .
- d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

C. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.
 - b. Foster Brand; H. B. Fuller.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
4. Aluminum Finish: Smooth.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Aeroflex USA.
 - c. Knauf Insulation.
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. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Knauf Insulation.
2. Width: 2 inches .
3. Thickness: 3.7 mils .
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Buckaroos, Inc.
 - b. McGuire Manufacturing.
 - c. Plumberex Specialty Products, Inc.
 - d. ProFlo; a Ferguson Enterprises, Inc. brand.
 - e. Truebro; IPS Corporation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProFlo; a Ferguson Enterprises, Inc. brand.
 - b. Truebro; IPS Corporation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents , unless otherwise approved by the engineer-of-record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-

ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 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.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- 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. 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.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. : 20 mils or 30 mils thick.
 - 2. Aluminum, Smooth: 0.016 inch, 0.020 inch, 0.024 inch, 0.032 inch, 0.040 inch thick.
 - 3. .

END OF SECTION 220719

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. **Drawn-Temper Copper Tube: ASTM B88, Type L & K.**
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. **Drawn-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.**
- E. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.

3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
- E. Install valves in accordance with the following:

- 1. Section 220523.12 "Ball Valves for Plumbing Piping."
- 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
- 3. Section 220523.14 "Check Valves for Plumbing Piping."

Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.
- H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. 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.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.

- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."
- R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
- S. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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 B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 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. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

- H. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- I. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- L. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

- C. Install hangers for copper pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper and tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of PP-R/PP-RCT pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

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 in accordance with 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.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. 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 installation 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. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
- f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- g. 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.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backflow preventers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Strainers for domestic water piping.
5. Outlet boxes.
6. Hose bibbs.
7. Wall hydrants.
8. Water-hammer arresters.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
6. Section 224723 "Remote Water Coolers" for water filters for water coolers.
7. Section 230923.18 "Leak Detection Instruments" for leak detection devices related to HVAC applications.
8. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

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

2.3 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
 - b. WATTS; A Watts Water Technologies Company.
 - c. **Zurn Industries, LLC.**
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.

- B. Backflow-Preventer Test Kits :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
 - b. WATTS; A Watts Water Technologies Company.
 - c. **Zurn Industries, LLC.**

2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.4 BALANCING VALVES

A. Automatic Flow Control Balancing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; a Division of Morris Group International.
 - b. Caleffi North America.
 - c. Circuit Solver.
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscaling polymer.
7. End Connections: Threaded or solder joint.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Lawler Manufacturing Company, Inc.
 - c. Symmons Industries, Inc.
 - d. **Leonard**
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted , thermostatically controlled, water mixing valve.
5. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless steel door.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. WATTS; A Watts Water Technologies Company.
 - b. Zurn Industries, LLC.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch 0.033 inch 0.062 inch .
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch 0.062 inch 0.125 inch
7. Drain: Factory-installed, hose-end drain valve.

2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guy Gray, IPS Corporation.
 - b. Oatey Co.
 - c. Sioux Chief Manufacturing Company, Inc.
2. Mounting: Recessed. Fire rated.
3. Material and Finish: Enameled-steel or epoxy-painted-steel Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Drain Outlet Connection: NPS 2.
6. Accessory: Water hammer arresters.
7. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
8. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
9. Inlet Hoses: Two 60-inch- long, rubber, household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
10. Drain Hose: One 48-inch- long, rubber, household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Guy Gray, IPS Corporation.
 - b. Oatey Co.
 - c. Sioux Chief Manufacturing Company, Inc.
2. Mounting: Recessed.

3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE BIBBS

A. Hose Bibbs :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle .
14. Operation for Finished Rooms: Wheel handle .
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Woodford Manufacturing Company.
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 .
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze .
12. Operating Keys(s): Two with each wall hydrant.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. WATTS; A Watts Water Technologies Company.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Piston .
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

- D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

3.2 PIPING 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.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Backflow preventers.
 - 2. Balancing valves.
 - 3. Temperature-actuated, water mixing valves.
 - 4. Outlet boxes.
 - 5. Wall hydrants.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to

identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each double-check, backflow-prevention assembly [**and**] double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

END OF SECTION 221119

SECTION 221123.21 - INLINE, DOMESTIC-WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontally mounted, in-line, close-coupled centrifugal pumps.

B. Related Requirements:

1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.
2. Section 331113 "Potable Water Supply Wells" for well pumps.

1.2 ACTION SUBMITTALS

- ##### A. Product Data Submittals:
- For each product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

- ##### A. Retain shipping flange protective covers and protective coatings during storage.
- ##### B. Protect bearings and couplings against damage.
- ##### C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- ##### A. Electrical Components, Devices, and Accessories:
- Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- ##### B. UL Compliance:
- UL 778 for motor-operated water pumps.

- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bell & Gossett; a Xylem brand.
 - 2. Taco Comfort Solutions.
- B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Results for Plumbing."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION OF PUMPS

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Pump Mounting:
 - 1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
 2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- E. Install pressure switches in water-supply piping.
- F. Install thermostats in hot-water return piping.
- G. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties." Comply with requirements for valves specified in the following:
1. Section 220523.12 "Ball Valves for Plumbing Piping."
 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 3. Section 220523.14 "Check Valves for Plumbing Piping."
 4. Section 220523.15 "Gate Valves for Plumbing Piping."

5. Install pressure gauge at suction of each pump and pressure gauge at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Results for Plumbing."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hubless, cast-iron soil pipe and fittings.
2. **PVC pipe and fittings.**

B. Related Requirements:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Hubless, cast-iron soil pipe and fittings.
2. **PVC pipe and fittings.**

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 FIELD CONDITIONS

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

- A. Piping materials to 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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Tyler Pipe; a subsidiary of McWane Inc.
 - 2. Standards: ASTM C1277 and ASTM C1540.
 - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Charlotte Pipe and Foundry Company.
 - 2. National Pipe and Plastic, Inc. (Oldcastle).
 - 3. Silver-line Plastics.
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- K. 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.
- L. 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.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: Two 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: Two percent downward in direction of flow.
 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- O. Install aboveground ABS piping in accordance with ASTM D2661.
- P. Install aboveground PVC piping in accordance with ASTM D2665.**
- Q. Install underground PVC piping in accordance with ASTM D2321.**
- R. Install engineered soil and waste and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- S. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 1. Cut threads full and clean using sharp dies.
 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- C. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. 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 stainless steel 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.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for 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.
- E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- F. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of 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.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 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 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 Plastic 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.

3.8 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:

1. Hubless, cast-iron soil pipe and fittings; and coupled joints. **(LINC only)**
 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. **(RHA only)**
- C. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. **(RHA & LINC)**

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Cleanouts.
- 2. Miscellaneous sanitary drainage piping specialties.

- B. Related Requirements:

- 1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
- 2. Section 077200 "Roof Accessories" for preformed flashings.
- 3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
- 4. Section 221323 "Sanitary Waste Interceptors" for metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.
- 5. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
- 6. Section 224300 "Healthcare Plumbing Fixtures" for plaster sink interceptors.
- 7. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M.
- 3. Size: Same as connected drainage piping
- 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 5. Closure: Countersunk , plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
- 3. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts :

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.

- b. Josam Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure Plug:
 - a. Cast iron.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
 7. Wall Access, Frame and Cover: Round , wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Vent Caps :

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

- E. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- F. Install vent caps on each vent pipe passing through roof.
- G. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- H. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- I. Install wood-blocking reinforcement for wall-mounting-type specialties.
- J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: .
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom .
9. Top Shape: Round .
10. Top Loading Classification: Heavy Duty.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

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SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, direct-vent, gas-fired, storage, domestic-water heater.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including storage tank and supports.
- b. Faulty operation of controls.
- c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

- a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

- 1) Storage Tank: Five years.
- 2) Controls and Other Components: One year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASME Compliance:
 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Direct-Vent, Gas-Fired, Storage, Domestic-Water Heaters:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A O Smith.
 - b. Bradford White Corporation.
 - c. **State Industries.**
 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
 3. Standard: ANSI Z21.10.1/CSA 4.1.
 4. Storage-Tank Construction: Steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
 5. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1.

- e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Burner: For use with direct-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - h. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
 - i. Temperature Control: Adjustable thermostat.
 - j. Combination Temperature-and-Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
6. Direct-Vent System: Through- roof, coaxial- or double-channel vent assembly with domestic-water heater manufacturers outside intake/exhaust screen.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 2. Maintain manufacturer's recommended clearances.
 3. Arrange units so controls and devices that require servicing are accessible.
 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 floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.

2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
- D. Install oil-fired, domestic-water heaters in accordance with NFPA 31.
1. Install shutoff valves on fuel-oil supply piping to oil-fired water-heater burners without shutoff valves. Comply with requirements for shutoff valves specified in Section 231113 "Facility Fuel-Oil Piping."
- E. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- H. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- I. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- J. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."
- K. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- L. Fill domestic-water heaters with water.
- M. Charge domestic-water expansion tanks with air to required system pressure.

- N. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."
- C. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."
- D. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 223400

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SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flush tanks.
3. Toilet seats.
4. Supports.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.
2. Section 224300 "Healthcare Plumbing Fixtures" for healthcare water closets.
3. Section 224600 "Security Plumbing Fixtures" for security water closets.

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power and control wiring.

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
5. Comply with ASME A112.6.1M for water-closet supports.
6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closet - Floor Type, 1.28 GPF, Flush Tank, Regular Use:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. Sloan Valve Company.
2. Two-piece elongated vitreous china floor type, with siphon jet bowl, tank and trim for 1.28 gal per flush, supply with stop valve and escutcheon, seat, bolts, caps with retainer clips, and 12" rough-in

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

E. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flush valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vitreous-china, wall-mounted lavatories.
2. Manually operated lavatory faucets.
3. Lavatory supports.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential lavatories.
2. Section 224300 "Healthcare Plumbing Fixtures" for healthcare lavatories.
3. Section 224600 "Security Plumbing Fixtures" for security lavatories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Rectangular, Vitreous China, Wall Mounted, with Back:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. Sloan Valve Company.
 - d. Zurn Industries, LLC.
2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Nominal Size: Rectangular, 20 by 18 inches.
 - d. Faucet-Hole Punching: Three holes, 4-inch centers.
 - e. Faucet-Hole Location: Top.
 - f. Color: White.
 - g. Mounting Material: Chair carrier.
3. Support: Type II, concealed-arm lavatory carrier
4. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

2.2 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Manual Type: Two-Handle Mixing, , :
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Chicago Faucets; Geberit Group.
 - c. Moen Incorporated. (**Preferred**)
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

4. Body Type: Centerset .
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): Wrist blade, 4 inches.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Operation: Noncompression, manual.
14. Drain: Not part of faucet.

2.3 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service sinks.
2. Handwash sinks.
3. Sink supports.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.
2. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments for automatic faucets.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Terrazzo, Floor Mounted: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fiat Products.
 - b. Florestone Products Co., Inc.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
 - a. Material: Marble chips cast in portland cement to produce a compressive strength of not less than 3000 psi, seven days after casting.
 - b. Shape: Square .
 - c. Nominal Size: 24 by 24 inches .
 - d. Height: 10 inches .
 - e. Tiling Flange: Not required .
 - f. Rim Guard: On all top surfaces.
 - g. Color: Not applicable .
 - h. Drain: Grid with NPS 3 outlet.
4. Mounting: On floor and flush to wall.

2.2 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Tabco.
 - b. Elkay.
 - c. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Stainless steel, self-rimming, sound-deadened unit less ledge back .
 - c. Number of Compartments: One .
 - d. Overall Dimensions: .
 - e. Material: 18 gauge, Type 304 stainless steel.
 - f. Compartment:
 - 1) Dimensions: .
 - 2) Drain: NPS 1-1/2 tailpiece with stopper .
 - 3) Drain Location: Centered in compartment .
 - 4) Depth: Standard .
 - g. Each Compartment:
 - 1) Dimensions: .

- 2) Drains: NPS 1-1/2 tailpiece with stopper .
 - 3) Drain Location: Centered in compartment .
 - 4) Depth: Standard .
4. Supply Fittings:
- a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose key .
 - 2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
5. Waste Fittings:
- a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2 .
 - 2) Material:
 - a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall ; and chrome-plated brass or steel wall flange.
 - b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless steel tube to wall; and stainless steel wall flange.
 - c. Continuous Waste:
 - 1) Size: NPS 1-1/2 .
 - 2) Material: Chrome-plated, 17-gauge brass tube.
6. Mounting: On counter with sealant.

2.3 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Two-handle mixing , .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets; Geberit Group.
 - b. Elkay.
 - c. **Moen.(Preferred)**
 - d. T&S Brass and Bronze Works, Inc.

2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Single hole .
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate .
8. Maximum Flow Rate: 1.5 gpm .
9. Mounting Type: Deck, exposed .
10. Valve Handle(s): Lever .
11. Spout Type: Swivel gooseneck .
12. Vacuum Breaker: Not required for hose outlet.
13. Spout Outlet: Laminar flow .

2.4 SINK SUPPORTS

A. Sink Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Josam Company.
 - c. Zurn Industries, LLC.
2. Source Limitations: Obtain sink supports from single source from single manufacturer.
3. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.

- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223 - COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Individual showers.
2. Shower heads and shower valves.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential showers.

1.2 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PMMA: Polymethyl methacrylate; also known as "acrylic."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Shower Valve Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Shower Valve Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Shower valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 SHOWER HEADS AND SHOWER VALVES

- A. Shower Head with Single-Handle, Thermostatic/Pressure-Balancing Mixing Valve: .
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets; Geberit Group.
 - b. Moen.**(Preferred)**
 - c. **Symmons**
 2. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.
 3. Description: Single-handle, accessible, thermostatic/pressure-balancing mixing valve with hot- and cold-water indicators; diverting valve check stops; and hose with handheld shower head on sliding rodshower head.
 4. Shower Valve:
 - a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016/ASME A112.1016/CSA B125.16.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate .
 - d. Mounting: Exposed.
 - e. Operation: Single-handle, or twist or rotate control.
 - f. Antiscald Device: Integral with mixing valve .
 - g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
 5. Supply Connections: NPS 1/2.
 6. Shower Head:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Type: Ball joint and head integral with mounting flange .
 - c. EPA WaterSense: Required.
 - d. Shower Head Maximum Flow Rate: 1.5 gpm .
 - e. Shower Head Material: Metallic with chrome-plated finish.
 - f. Spray Pattern: Adjustable Fixed.
 - g. Integral Volume Control: Required.
 - h. Temperature Indicator: Integral with valve .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine rough-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.
- B. Examine walls and floors for suitable conditions where showers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble shower components according to manufacturers' written instructions.
- B. Install showers level and plumb.
- C. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" Install valves in locations that are accessible for ease of operation.
- D. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- E. Set shower receptors and shower basins in leveling bed of cement grout.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220500 "Common Work Results for Plumbing."
- G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

- B. Adjust water pressure at shower valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of showers and basins, inspect and repair damaged finishes.
- B. Clean showers and basins, shower valves, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of showers and basins for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

SECTION 224300 - HEALTHCARE PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Healthcare water closets.
2. Healthcare lavatories.
3. Healthcare shower valves.

B. Related Requirements:

1. Section 224213.13 "Commercial Water Closets" for conventional water closets, flushometer valves, carriers, and seats for use healthcare facilities, but not requiring special healthcare fixture attributes.
2. Section 224216.13 "Commercial Lavatories" for lavatories for use in healthcare facilities, but not requiring special healthcare fixture attributes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and faucets.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of flushometer valves.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A112.19.3/CSA B45.4 for stainless steel plumbing fixtures.
- B. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.

- C. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets.
- D. Comply with ASME A112.18.1/CSA B125.1 for plumbing supply fittings.
- E. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- F. Comply with IAPMO Z124.5 for water-closet (toilet) seats.
- G. Comply with ASME A112.6.1M for plumbing fixture supports.
- H. Comply with ASSE 1016/ASME A112.1016/CSA B125.16 for shower valves.
- I. Comply with ICC A117.1 for ADA-compliant, accessible plumbing fixtures and installation.
- J. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous-china water closets to sanitary drainage systems.
- K. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous-china water closets to sanitary drainage systems.
- L. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- M. Faucets and bubblers intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 HEALTHCARE WATER CLOSETS

- A. Healthcare Ligature Resistant Water Closets, Stainless Steel, Floor Mounted, Floor Outlet, Top Spud , Accessible: .
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Whitehall Manufacturing; a division of Morris Group International.
 - b. Willoughby Industries, Inc.
 - c. **Behavioral Safety**
 - d. **Acorn**
 - 2. Bowl:
 - a. Material: Stainless steel.
 - b. Finish: Powder coated.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve .
 - e. Height: Standard ADA.
 - f. Rim Contour: Elongated with bedpan lugs or slots.
 - g. Water Consumption: 1.28 gal. per flush.

- h. Spud Size: NPS 1-1/2.

2.3 Healthcare Ligature Lavatories, Stainless Steel, Wall Mounted, Accessible:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Whitehall Manufacturing; a division of Morris Group International.**
 - b. **Willoughby Industries, Inc.**
 - c. **Behavioral Safety**
 - d. **Acorn**
2. **Bowl:**
 - a. **Material: Stainless steel.**
 - b. **Finish: Powder coated.**
 - c. **Type: Wall mounted.**
 - d. **Faucet-Hole Punching: Three holes, 4-inch centers.**
 - e. **Height: Standard ADA.**
 - f. **Standard: CS730.**

2.4 HEALTHCARE SHOWER VALVES

A. Healthcare Shower Valves, Pressure-Balance Mixing Valve: .

1. **Manufacturers: Subject to compliance with requirements, provide products by the following:**
 - a. **Whitehall Manufacturing.**
 - b. **Willoughby Industries, Inc.**
 - c. **Behavioral Safety**
 - d. **Acorn**
2. **Valve:**
 - a. **Body Material: Solid brass.**
 - b. **Finish: Polished chrome plate.**
 - c. **Maximum Flow Rate: 1.5 gpm unless otherwise indicated.**
 - d. **Mounting: Exposed.**
 - e. **Operation: Single-handle, or twist or rotate control.**
 - f. **Antiscald Device: Integral with mixing valve .**
 - g. **Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water-supply connections.**
 - h. **Indicators: For hot and cold water.**
3. **Shower Head:**
 - a. **Type: Integral with mounting flange Wall-mounted .**
 - b. **Shower Head Material: Metallic with chrome-plated finish.**
 - c. **Spray Pattern: Fixed.**

- d. Integral Volume Control: Not required .
- e. Shower-Arm, Flow-Control Fitting: 1.5 gpm .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HEALTHCARE PLUMBING FIXTURES

- A. Install healthcare plumbing fixtures level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install floor-mounted healthcare water closets on bowl-to-drain, connecting fitting attachments to piping or building substrate.
- D. Install counter-mounted fixtures in, and attached to, casework.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception for use of ball or gate valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- F. Install flushometer valves on healthcare water closets.
- G. Install flushometer valves for accessible healthcare water closets, with lever handle mounted on wide side of compartment.
- H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- I. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- J. Install traps on fixture outlets.

1. Exception for omission of trap on fixtures with integral traps.

- K. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- L. Seal joints between healthcare plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- M. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean healthcare plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of healthcare plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224300

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Drinking fountains.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.4 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Drinking fountains and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2. Comply with ASME A112.19.3/CSA B45.4 for stainless steel drinking fountains and bottle filling stations.
3. Comply with NSF 42 and NSF 53 for water filters for drinking fountains and bottle filling stations.
4. Comply with ICC A117.1 for accessible drinking fountains and bottle filling stations.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains - Surface Wall-Mounted, Composite/Granite: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay.
 - b. Halsey Taylor.
 - c. Oasis.
2. Source Limitations: Obtain surface wall-mounted, composite/granite drinking fountains from single source from single manufacturer.
3. Type: Vandal resistant .
4. Receptor(s):
 - a. Type: With back .
 - b. Shape: Rectangular .
 - c. Back Panel: Stainless steel wall plate behind drinking fountain.
 - d. Bubblers: One for each receptor, with adjustable stream regulator, located on deck.
 - e. Drain: Grid type with NPS 1-1/4 tailpiece.
5. Maximum Water Flow: 0.5 gpm .
6. Control: Push bar .
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
9. Filter: One or more water filters with capacity sized for unit peak flow rate.
10. Electrical Characteristics:
 - a. Volts: 120 V ac.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.
11. Support: Provide manufacturer's mounting plate drinking fountain carrier .
12. Drinking Fountain Mounting Height: Standard Accessible in accordance with ICC A117.1 High/low - standard/accessible in accordance with ICC A117.1.
13. Freeze-Resistant Supply Fittings: Through wall freeze-resistant shutoff and flow-control valve assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains and bottle filling stations on flat surface in accordance with manufacturer's written installation instructions.
- C. Install recessed, drinking fountains and bottle filling stations secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for drinking fountain. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motors.
2. Thermometers, bimetallic actuated.
3. Duct-thermometer mounting brackets.
4. Thermowells.
5. Test plugs.
6. Test-plug kits.

B. Related Requirements:

1. Section 231123 "Facility Natural-Gas Piping" for gas meters.
2. Section 232216 "Steam and Condensate Piping Specialties" for steam and condensate meters.
3. Section 230923.13 "Energy Meters" for thermal-energy meters connecting with the DDC system.
4. Section 230923.14 "Flow Instruments" for primary flow instruments connecting with the DDC system.

1.2 DEFINITIONS

- ##### A. Existing Piping To Remain:
- Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.
 - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
 - b. Include operating characteristics and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- ##### A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.7 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Rotor: Random-wound, squirrel cage.
6. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
7. Temperature Rise: Match insulation rating.
8. Insulation: Class F .
9. Code Letter Designation:
 - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
10. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T .

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
 - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

3.2 ADJUSTING

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

3.3 FIELD QUALITY CONTROL

3.4 THERMOMETER APPLICATION

- A. Thermometers at outside-, return-, supply-, and mixed-air ducts are to be the following:
 - 1. Sealed, bimetallic-actuated type.
- B. Thermometer stems are to be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE APPLICATION

- A. Scale Range for Air Ducts:
 - 1. Minus 40 to plus 160 deg F and minus 40 to plus 100 deg C.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F .
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- L. Motors indicated on the drawings as being controlled by variable frequency drives shall be provided with factory-installed shaft grounding rings, which shall consist of a circumferential ring of conductive microfibers that discharge shaft voltages to ground.
 - 1. Manufacturer: Aegis Sgr.

2.4 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation.

Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Neoprene Isolation Washers and Grommets
4. Open-spring isolators.
5. Restrained-spring isolators.
6. Pipe-riser resilient support.
7. Resilient pipe guides.
8. Elastomeric hangers.
9. Spring hangers.
10. Precompressed Spring Hangers
11. Manufactured Pipe Isolation Hangers
12. Field Assembled Pipe Isolation Hangers
13. Snubbers.
14. Restraints - rigid type.
15. Restraints - cable type.
16. Restraint accessories.
17. Post-installed concrete anchors.
18. Concrete inserts.
19. Vibration isolation equipment bases.
20. Flexible Connections
21. Thrust Restraints

- B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

- A. Designated Seismic System: An HVAC component that requires design in accordance with ASCE/SEI 7, Ch. 13, and for which the Component Importance Factor is greater than 1.0.

- B. IBC: International Building Code.
- C. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include vibration isolation mounts and hangers, including isolator data, manufacturer's equipment operating weight, actual load distribution and actual static deflection at each loading point for each piece of isolated equipment.
 - 2. Include equipment base details including dimensions, structural member size, and support point locations.
 - 3. Include flexible duct and pipe connector data sheets including manufacturer's ratings for pressure and temperature.
 - 4. Include load rating for each wind-force-restraint fitting and assembly.
 - 5. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic- and wind-force-restraint component.
 - 6. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing an agency acceptable to authorities having jurisdiction.
 - 7. Annotate to indicate application of each product submitted and compliance with requirements.
 - 8. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Wind-Force Performance Certification: Provide special certification for HVAC components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
 - 1. Provide equipment manufacturer's written certification for each designated HVAC device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
 - 2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
 - 3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7 and be acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Load Design Calculations:

1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise noted.
 - a. Data indicated in the Drawing schedules that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Coordinate design wind-load calculations with seismic load calculations for equipment requiring both seismic and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.

B. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723 and be so labeled.

C. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE 7-05 Section 13.6.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: NP.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.

5. Ribbed or waffled on both sides.
6. Minimum thickness 0.75 inches.
7. Load-bearing metal plates adhered to pads as recommended by isolation pad manufacturer for loading conditions.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: DN.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.4 NEOPRENE ISOLATION WASHERS AND GROMMETS

A. Neoprene Isolation Washers and Grommets: IWG.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Neoprene isolation washer and grommets shall have a nominal durometer of Shore 50A.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: FS.

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

- a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Unhoused combination spring with neoprene type.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Baseplate shall limit floor load to 500 psig.
 8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: LS.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base shall limit floor load to 500 psig.
 - b. Internal leveling bolt that acts as blocking during installation.
3. Combination spring and neoprene type.
4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 - a. Limit stops shall be out of contact with the housing during normal operation.
5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 PIPE-RISER RESILIENT SUPPORT

- A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch- Thick Neoprene: NA.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mounting & Controls, Inc.
 2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.8 RESILIENT PIPE GUIDES

- A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch- Thick Neoprene: NR.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.

2.9 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: NH.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
 2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.10 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: SH.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.11 PRECOMPRESSED SPRING HANGERS

A. Precompressed Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: PSH.

1. Shall meet all of the specified requirements of Type SH spring hangers.
2. Shall be provided precompressed by the manufacturer to the rated deflection. Hanger shall have a release mechanical to free the spring after installation is complete.

2.12 MANUFACTURED PIPING ISOLATION HANGER

A. Pipe Hanger Manufactured With Elastomeric Vibration Isolation Layer: PIM.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. HoldRite
 - b. Elmdor Stoneman
 - c. F&A Products, Inc.

2. Elastomeric Layer: 30-50 durometer ribbed neoprene, thermoplastics rubber, or crumb rubber.
3. Inside diameter sized for piping outside diameter.

2.13 FIELD ASSEMBLED PIPING ISOLATION HANGER

A. Field Assembled Piping Isolation Hanger Treatment: PIF.

1. 1/2" thick closed cell elastomeric foam insulation layer installed between the pipe and hanger.
2. Minimum 3" wide strip or as required to provide 1" overhang on each side of support pipe.
3. Oversize pipe hangers by a minimum of 3/4" to prevent crushing of foam insulation.
4. Multiple layers of closed cell insulation may be used to reach the required thickness.
5. Closed cell foam insulation to be Armacell AP or Equal.

2.14 SNUBBERS

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

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Eliminator Co., Inc.
4. Vibration Mountings & Controls, Inc.
5. Vibro-Acoustics.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
2. Anchors in Masonry: Design in accordance with TMS 402.
3. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
4. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.15 RESTRAINTS - RIGID TYPE

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

1. CADDY; nVent.
2. Gripple Inc.
3. International Seismic Application Technology (ISAT).
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Mountings & Controls, Inc.
8. Vibro-Acoustics.

- B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.16 RESTRAINTS - CABLE TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; nVent.
 2. Gripple Inc.
 3. International Seismic Application Technology (ISAT).
 4. Kinetics Noise Control, Inc.
 5. Mason Industries, Inc.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Mountings & Controls, Inc.
 8. Vibro-Acoustics.
- B. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.17 RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; nVent.
 2. Gripple Inc.
 3. International Seismic Application Technology (ISAT).
 4. Kinetics Noise Control, Inc.
 5. Mason Industries, Inc.
 6. Vibration Eliminator Co., Inc.
 7. Vibration Mounting & Controls, Inc.
 8. Vibro-Acoustics.
- B. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- C. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- D. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.18 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DeWALT.
 - b. Hilti, Inc.
 - c. Simpson Strong-Tie Co., Inc.
2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DeWALT.
 - b. Hilti, Inc.
 - c. Simpson Strong-Tie Co., Inc.
2. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp (7.46 kW) that is not vibration isolated.

1. Undercut expansion anchors are permitted.

2.19 CONCRETE INSERTS

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

1. DeWALT.
2. Gripple, Inc.

3. Hilti, Inc.
4. International Seismic Application Technology (ISAT).
5. Simpson Strong-Tie Co., Inc.

- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

2.20 VIBRATION ISOLATION EQUIPMENT BASES

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

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Eliminator Co., Inc.
4. Vibration Mountings & Controls, Inc.
5. Vibro-Acoustics.

- B. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete: CIB.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
5. The weight of each inertia base shall be sufficient to lower the center of gravity to or below the isolator support plane for installations with seismic or wind loading requirements. For non-seismic and non-wind loaded conditions weight of each base shall be at least equal to the weight of the equipment mounted thereon.
6. Inertia bases shall be a minimum of 6" thick.

2.21 RESTRAINED ISOLATION ROOF-CURB RAILS

- A. Spring Isolation Curbs: SC.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Kinetics Noise Control, Inc.

2. Mason Industries, Inc.
 3. Vibration Eliminator Co., Inc.
 4. Vibration Mountings & Controls, Inc.
 5. Vibro-Acoustics.
- C. Description: Factory-assembled, fully enclosed, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- D. Upper Frame: To provide continuous support for equipment and to be captive to resiliently resist seismic and wind forces.
- E. Lower Support Assembly: Containing adjustable and removable steel springs that support the upper frame. Lower support assembly to have a means for attaching to building structure or a wood nailer for attaching roof materials, and to be insulated as required of rigid, glass-fiber insulation on inside of assembly. Mount adjustable, restrained-spring isolators on elastomeric vibration isolation pads and provide access ports, for level adjustment, with removable waterproof covers at all isolator locations. Locate isolators so they are accessible for adjustment at any time during the life of the installation without interfering with integrity of roof.
- F. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- G. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past lower support assembly, and counterflashed over roof materials.

2.22 ELASTOMERIC CURB ISOLATION

- A. Elastomeric Curb Isolation Pad: ECIP.
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
 2. Description: Elastomeric curb isolation pad installed between roof mounted equipment and supporting curb.
 3. Minimum 0.5" elastomeric layer thickness.
 4. Minimum 1.75" elastomeric layer width.
 5. 40-60 durometer neoprene or high density compressed molded fiberglass individually coated with a flexible moisture impervious membrane.
 6. Elastomeric layer surface finish shall allow a weather proofed seal at top and bottom joint.
 7. Adhered to curb and equipment with mastic adhesive without need of rigid connection. Sealed weather tight at all joints with silicone caulk.

2.23 FLEXIBLE CONNECTORS

A. Flexible Elastomeric Pipe Connectors

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Single-sphere and twin-sphere types, made of multiple plies of nylon cord fabric and neoprene, hydraulically molded.
3. Connectors through 1.5" shall have threaded ends. Connectors 2" and large shall have flanged ends with recessed groove to receive the connector's raised neoprene face.
4. Connectors 4" and larger operating above 100 psig, and any sizes and pressures as required by flex connector manufacturer, shall have isolated limit stops to prevent overextension and overcompression.
5. Limit stops shall be either control cables with neoprene isolated end fitting and anti-compression stops, control rods with neoprene isolation washers and bushings, or spring isolated control units.
6. Connectors shall be line size and shall be designed for the pressures and temperatures encountered in the system, minimum 150 psig and 250° F.

B. Flexible Metal Hose Connectors

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Stainless steel corrugated type with stainless steel woven braid outer sheath.
3. Minimum Live Lengths:
 - a. Pipe diameters up to 2.5" - 12" minimum live length.
 - b. Pipe diameters 3" to 4" - 18" minimum live length.
 - c. Pipe diameters 5" to 10" - 24" minimum live length.
 - d. Pipe diameters 12" or greater - 36" minimum live length.

C. Flexible Duct Connector

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.

- b. Duro-Dyne.
 - c. Ventfabrics.
- 2. Fabric, fiberglass, or EPDM flexible connections.
 - 3. Connections shall comply with NFPA 90A-2018, NFPA 701-2019, and shall be asbestos-free and designed for continuous use at 275° F.
 - 4. Connections to laboratory exhaust equipment shall be designed for use with acidic fumes.
 - 5. Connections exposed to weather shall be sunlight and ozone resistant.
 - 6. Flexible sections shall be wide enough to allow at least 2" of flexible separation in installed conditions.

2.24 THRUST RESTRAINTS

A. Spring Thrust Restraints

- 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
- 2. A set (2 or more per installation location) of spring thrust resisting assemblies consisting of coil springs, spring retainers, isolation washers, angle mounting brackets, and elastomeric tubing for isolating thrust rods.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static , wind load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL , WIND-LOAD CONTROL, AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawing Plans, General Notes, Schedules, and/or Details, or where Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators, wind-load restraints, must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- F. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- G. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Brace a change of direction longer than 12 feet.
- H. Install seismic- and wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Mechanical Anchor Bolts:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Variable-air-volume systems.
 - b. Multizone systems.
 - c. Induction-unit systems.
- 2. Testing, adjusting, and balancing of fuel oil systems for HVAC.
- 3. Testing, adjusting, and balancing of steam and condensate piping systems.
- 4. Testing, adjusting, and balancing of equipment.
- 5. Testing, adjusting, and balancing of existing HVAC systems and equipment.
- 6. Duct leakage tests verification.
- 7. Pipe leakage tests verification.
- 8. UFAD plenum leakage tests verification.
- 9. HVAC-control system verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.7 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.8 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.
 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment

performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.
- K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems. Include proposed locations for duct traverses.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:

- a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
- b. Duct systems are complete with terminals installed.
- c. Volume, smoke, and fire dampers are open and functional.
- d. Clean filters are installed.
- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
- b. Piping is complete with terminals installed.
- c. Water treatment is complete.
- d. Systems are flushed, filled, and air purged.
- e. Strainers are pulled and cleaned.
- f. Control valves are functioning in accordance with the sequence of operation.
- g. Shutoff and balance valves have been verified to be 100 percent open.
- h. Pumps are started and proper rotation is verified.
- i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete, and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Fans and ventilators.
 - 3. Terminal units.
 - 4. Commercial kitchen hoods.
 - 5. Furnaces.
 - 6. Air-handling units.
 - 7. Heating and ventilating units.
 - 8. Self-contained air conditioners.
 - 9. Split-system air conditioners.
 - 10. Variable-refrigerant-flow systems.
 - 11. Heat pumps.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located as shown on the Drawings.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
 - g. Zero pressure transducer with no airflow through terminal unit.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
6. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet.
 - b. Measure static pressure directly at the fan inlet.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Balance the return-air ducts and inlets.

- b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
 - d. Mark final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return fans.

3.7 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.
- B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.
- C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.
- D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Architect Owner Construction Manager Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- F. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlet and outlet airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- G. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.8 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.10 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.11 UFAD PLENUM LEAKAGE TESTS

- A. Witness the UFAD plenum pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.12 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 - 1. Verify HVAC control system is operating within the design limitations.
 - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 - 3. Verify that controllers are calibrated and function as intended.
 - 4. Verify that controller set points are as indicated.
 - 5. Verify the operation of lockout or interlock systems.
 - 6. Verify the operation of valve and damper actuators.
 - 7. Verify that controlled devices are properly installed and connected to correct controller.
 - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
 2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
 3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 4. Check the refrigerant charge.
 5. Check the condition of filters.
 6. Check the condition of coils.
 7. Check the operation of the drain pan and condensate-drain trap.
 8. Check bearings and other lubricated parts for proper lubrication.
 9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.14 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
 3. Heating-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.

4. Chilled-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.
5. Condenser-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Prepare a NEBB certified written report complying with NEBB minimum requirements; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.

9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Heating coil, dry-bulb conditions.
 - e. Face and bypass damper settings at coils.
 - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - g. Variable-frequency controller Inlet vane settings for variable-air-volume systems.
 - h. Settings for pressure controller(s).
 - i. Other system operating conditions that affect performance.
 16. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Terminal units.
 5. Balancing stations.
 6. Position of balancing devices.
 7. Control device locations (e.g. static pressure and differential pressure sensors).
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.

- g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Inlet and discharge static pressure in inches wg.
 - e. For each filter bank, filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
 - j. Outdoor airflow in cfm.
 - k. Return airflow in cfm.
 - l. Outdoor-air damper position.
 - m. Return-air damper position.
 - n. Vortex damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
- a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.

- b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.

- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System fan and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:

- a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.

M. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.17 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect or Commissioning Authority, if applicable.
- B. Architect or Commissioning Authority, if applicable, shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

- F. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Outdoor, exposed supply and return.

B. Related Requirements:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

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 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.4 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

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.

1.5 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 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 are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, 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; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA

or Type IB. For duct and plenum applications, provide insulation 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; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.

2.3 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Johns Manville; a Berkshire Hathaway company.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.
 - b. Certainteed; SAINT-GOBAIN.
 - c. Thermal Ceramics.
 - d. Unifrax Corporation.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool 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. Foster Brand; H. B. Fuller Construction Products.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: 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 C755, 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.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above 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: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Color: White .

2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
 - 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. Vimasco Corporation.
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.

3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

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.
2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.8 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Johns Manville; a Berkshire Hathaway company.

C. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Polyguard Products, Inc.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
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.

2.11 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Avery Dennison Corporation, Specialty Tapes Division.
 - c. Knauf Insulation.
 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.

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, compress, or otherwise damage insulation or jacket.
- 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. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- 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, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 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 4 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.
- 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 Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- B. Comply with manufacturer's written installation instructions.
 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 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.
- C. 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 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.

3.6 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.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.
- D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 DUCT INSULATION SCHEDULE, GENERAL

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

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation is the following:

1. Glass-Fiber Blanket: 2.2 inches thick and 0.75 lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, outdoor-air duct insulation is the following:

1. Glass-Fiber Blanket: 2 inches thick and 0.75 lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation is the following:

1. Glass-Fiber Blanket: 2.2 inches thick and 0.75 lb/cu. ft. nominal density.

D. Concealed, rectangular, outdoor-air duct insulation is the following:

1. Glass-Fiber Blanket: 2.2 inches thick and 0.75 lb/cu. ft. nominal density.

E. Concealed, supply-air plenum insulation is the following:

1. Glass-Fiber Blanket: 2.2 inches thick and 0.75 lb/cu. ft. nominal density.

F. Concealed, outdoor-air plenum insulation is the following:

1. Glass-Fiber Blanket: 2.2 inches thick and 0.75 lb/cu. ft. nominal density.

G. Exposed, round and flat-oval, supply-air duct insulation is the following:

1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

H. Exposed, round and flat-oval, outdoor-air duct insulation is the following:

1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

I. Exposed, rectangular, supply-air duct insulation is the following:

1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

J. Exposed, rectangular, outdoor-air duct insulation is the following:

1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- K. Exposed, supply-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- L. Exposed, outdoor-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 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, round and flat-oval, supply-air duct insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- C. Exposed, round and flat-oval, return-air duct insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- D. Exposed, rectangular, supply-air duct insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- E. Exposed, rectangular, return-air duct insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- F. Exposed, supply-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 lb/cu. ft. nominal density.

- G. Exposed, return-air plenum insulation is the following:
 - 1. Glass-Fiber Board: 2 inches thick and 6 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, Concealed:
 - 1. Aluminum, : 0.016 inch thick.

- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Aluminum, : 0.016 inch thick.
 2. Painted Aluminum, : 0.016 inch thick.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations: 0.032 inch 0.040 inch thick.

END OF SECTION 230713

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General provisions and HVAC systems are specified in other Sections of Division 23.
- B. This Section covers automatic temperature control systems and equipment.
- C. This Section includes responsibilities and obligations in support of the performance verification specified in Section 230090, HVAC Performance Verification.
- D. The BCS includes the network of interoperable, stand-alone digital controllers communicating via network devices. The BCS shall integrate with the existing New Hanover County Metasys System.

1.2 RELATED WORK

- A. The installation of motor starters that are not factory-installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, electric heating coils, and contactors, is specified in another Division. This Section includes the furnishing and installation of controls and wiring for automatic controls, electric damper and motors, terminal unit controllers, interlocks, starting circuits, and 120 V and low voltage power wiring to power consuming control devices.
- B. Area smoke detectors are provided, installed and wired under Division 28. Duct smoke detectors shall be installed under Division 23, but furnished and wired into the fire alarm system under Division 28. This Section includes wiring fire alarm signal relays, provided and installed under another Division, to the automatic temperature control systems.
- C. The monitoring and data logging capabilities of the BCS shall be available for use in the commissioning process.

1.3 QUALITY ASSURANCE

- A. Within 30 days after notice to proceed, submit resumes for the project manager, application engineer and field supervisor assigned to the Project. The Owner and Engineer reserve the right to exclude proposed staff not having the experience deemed sufficient for the Project. The proposed staff shall have the following minimum experience levels:
 - 1. Project manager: 5 years experience, and two projects of similar size and type.
 - 2. Application engineer: 7 years experience, and be manufacturer-certified for the system being provided, and Niagara 4 certified.
 - 3. Field supervisor: 5 years experience, and be manufacturer-certified for the system being provided, and Niagara 4 certified.

- B. Conform to the following:
 - 1. NFPA 70-2021.
 - 2. North Carolina State Electrical Code-2018.
- C. Installation shall be by technicians trained by the control manufacturer.
- D. Controllers and software shall have a current BTL listing.

1.4 SOFTWARE LICENSING

- A. The BCS software license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement.
- B. The Owner shall be the named license holder of all BCS software associated with the Project. In addition, the Owner shall receive ownership of all Project specific configuration documentation, data files, and application-level software developed for the Project. This shall include all custom, Project specific software code and documentation for all configuration and programming that is generated for this Project and configured for use with the BCS, NACs, and related communications devices. Required usernames and passwords for access to any component or software program shall be provided to the Owner.
- C. The NACs and other Niagara framework components shall have an unrestricted interoperability license with a Niagara Compatibility Statement (NiCS) following the Tridium Open NiCS Specification and shall have a value of "All" for "Station Compatibility In", "Station Compatibility Out", "Tool Compatibility In" and "Tool Compatibility Out". Note that this will result in the following entries in the license.dat file:
 - 1. "accept.station.in=*"
 - 2. "accept.station.out=*"
 - 3. "accept.wb.in=*"
 - 4. "accept.wb.out=*"

1.5 SUBMITTALS

- A. Submit a single comprehensive submittal package including the following items. At the Contractor's option, control dampers may be submitted in a separate submittal in advance of the other items to maintain project schedule.
 - 1. Control damper data: including manufacturer's product data and schedule indicating damper type, size, flow rate, pressure drop, leakage rate, actuators and motors, actuator torque, end switches and normal (failure) position for each damper.
 - 2. Pressure sensor data: including manufacturer's product data and schedule indicating the sensor type, range, and accuracy, and denoted with a discrete tag for each sensor and a description of the associated system and mounting location.
 - 3. BCS data: including control manufacturer's data sheets on BCS controllers, NACs, sensors, meters, relays, actuators, motors, terminal unit controllers, protection devices, and other devices specified herein. Include data on software.

4. Network data: including switches, converters, routers, broadcast management devices and cabling, as necessary.
5. Graphics: include illustrations of proposed graphics displays, including a flowchart or site map indicating system navigation links.
6. Diagrams: separate field wiring diagrams for each system, including motor starting and interlock wiring, ladder diagrams, control wiring, interior electrical circuits of control instruments with terminal and control device designations, actuators and motors, colors of wires, locations of instruments and remote elements, interfaces with communications equipment provided with equipment specified in other Sections, and normal position of relays. Each diagram shall have terminals labeled as they will be marked on the installed equipment.
7. System architecture: provide a drawing of the proposed system architecture showing configuration and locations for BCS controllers, terminal unit controllers, control wiring for each device, and hardware and wiring for connections. Indicate the spare capacity and BACnet instance number or network address for each device. Include networking hardware such as switches, converters, routers, and broadcast management devices, and indicate IP addresses. Provide diagrams of the proposed control power infrastructure, including the designation of the electrical panelboards that will be utilized to provide control power, the quantity, configuration, size, and location of controls system transformers, and the distribution wiring to power consuming control devices. Provide floor plans locating equipment coordinated with the work of other trades.
8. Sequences of operation: complete detailed sequences of operation, including a narrative of the system operation and interactions and interlocks with other systems, notations indicating whether interlock or interaction is accomplished through software or hardwired connections, detailed delineation of control between packaged controls and the BCS, and sequences of operation for packaged controlled equipment that interfaces with the BCS.
9. System implementation requirements: network, and Web browser requirements for BCS functionality on the Owner's systems. Indicate operating system and java requirements for compatibility.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Johnson Controls Metasys
- B. The manufacturers' product lines specified above shall be a complete system of NACs, BCS controllers, and terminal unit controllers used consistently throughout the Project. BCS and terminal unit controllers shall be programmable from the NACs and existing server using a Niagara 4 browser platform with embedded workbench tools or separate web-accessible tools on the server. Programming tools and license shall be open and provided to the Owner.

2.2 SYSTEM ARCHITECTURE

- A. Provide a complete peer-to-peer networked, stand-alone, distributed BCS to perform the controls functions and monitor the points specified herein and on the Drawings. The BCS shall be engineered and equipment selected by the manufacturer as required to meet the performance specified herein. The BCS shall be comprised of a network of interoperable, stand-alone digital

controllers communicating via the BACnet communication protocols with one or multiple NACs. Lower level networks utilizing BACnet over MS/TP shall only serve terminal units. The BCSs shall interface with the electric and electronic systems to provide control outputs and monitoring inputs to the BCSs as specified herein and as indicated on the Drawings. Provide communications media, connectors, repeaters, bridges, switches, and routers necessary to provide a fully functional BCS network. Complete electric control systems shall be provided to perform sequences not indicated to be performed by the BCSs. The location and quantity of BCS controllers shall be as determined by the BCS manufacturer except that, as a minimum, a separate stand-alone controller shall be provided for each refrigeration plant, heating plant, air handling unit over 3 hp, and as indicated on the Drawings. Sensors and control points for each system shall be connected to its associated stand-alone controller. Each BCS controller shall be designed to allow for the future addition of at least 20% of the number of connected input/output points; it is acceptable to achieve the 20% spare capacity with 10% spare on the BCS controller with capability of adding input/output expansion modules with an additional 10%. BCS controller spare capacity shall apply to both analog and digital control points. The BCS, the network components, and network area controllers (NACs), shall be designed to allow for the future addition of at least 100% of the number of control objects connected to the components or systems. An alarm condition shall be reported to the appropriate operator device no more than 10 seconds following the occurrence of that condition. Sensor and control values displayed to the operator in graphics displays shall be dynamically updated within 10 seconds of significant change of value, with a typical response time of 1 second or less.

- B. Lower level networks serving terminal units, such as BACnet over MS/TP, shall be connected to the associated air handling unit controller. When multiple lower level networks are required for a single air handling unit, those networks shall be divided in an orderly method, such as by floor or wing. Remote sensors shall be wired to the controller associated with that sensor, unless specified otherwise.
- C. The system shall have the capability to integrate ASHRAE 135-2016, BACnet, LonMark, MODBUS, OPC, and other open and proprietary communication protocols into one open, interoperable system.
- D. The following functions shall be performed at the existing server or NAC:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - a. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - 1) In alarm.
 - 2) Return to normal.
 - 3) Fault condition.
 - b. Provide for the creation of a minimum of 8 alarm classes.
 - c. Provide time scheduled routing of alarms by class, object, group, or node.
 - d. Provide alarm generation for equipment runtimes and other event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

- e. Controller and network failures shall be treated as alarms and annunciated.
 - f. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text.
 - 2) E-mail of the complete alarm message to multiple recipients via the Owner's e-mail service. Provide the ability to route and e-mail alarms based on:
 - a) Day of week.
 - b) Time of day.
 - c) Recipient.
 - d) Pagers.
 - e) Graphics showing flashing items in alarm.
 - f) Printed message, routed directly to a dedicated alarm printer.
 - g. The following, at a minimum, shall be recorded:
 - 1) Time and date.
 - 2) Location (building, floor, zone, office number, etc.).
 - 3) Equipment (air handling unit number, access way, etc.).
 - 4) Acknowledge time, date, and user who issued acknowledgement.
 - 5) Number of occurrences since last acknowledgement.
 - h. Alarm actions may be initiated by user-defined programmable objects created for that purpose.
 - i. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms.
 - j. A log of all alarms shall be maintained by the NAC and/or existing server (if configured in the system) and shall be available for review by the user.
 - k. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- 5. Time synchronization.
 - 6. Web browser access via an intranet and the internet, supporting a minimum of 32 simultaneous users.
 - 7. The following additional logs shall be included and made available to the user:
 - a. System alerts, such as controller and network failures.
 - b. Errors, such as invalid property changes or commands.

2.3 CONTROLLERS

A. Network Area Controllers (NACs):

- 1. The Contractor shall supply one or more NACs. The quantity and location of NACs is dependent on the type and quantity of control points and devices, and the functionality specified herein, and shall be determined by the Contractor.
- 2. NACs shall provide the interface between the building's communications system and the BCS control devices, and provide global supervisory control functions over the control devices connected to each NAC. It shall be capable of executing application control programs. It shall perform the following functions:

- a. Integration of LonWorks and BACnet controller data.
 - b. Network management functions for control devices.
3. NACs shall have the following hardware features as a minimum:
- a. Two ethernet ports - 10/100 Mbps.
 - b. One LonWorks interface port - 78KB FTT-10A.
 - c. Two RS-485 ports.
 - d. Battery back-up and flash memory for long term data backup, with minimum 1 gigabyte storage capacity.
4. NACs shall be capable of operating under a temperature range between 32°F to 122°F and a humidity range between 5% to 95% RH, non-condensing, and of being stored under a temperature range between 0°F and 158°F.
5. NACs shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NACs shall be an ODBC-compliant database or shall provide an ODBC data access mechanism to read and write data stored within it.
6. Alarm Notifications and Actions:
- a. NACs shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - b. NACs shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
- B. BCS controllers: field programmable, microprocessor-based type incorporating direct digital control and energy management functions. Each BCS controller shall perform its assigned control and energy management functions as a stand-alone unit and shall comply with FCC Part 15, Subpart B 2019. Provide a communication interface for communication with the BCS. Controls shall be performed in a digital manner using the digital signal from the microprocessor-based controller, converted through electronic circuitry for modulation of actuators. Each BCS controller shall be expandable by adding additional input/output modules that operate through the processor of the BCS controller. The master processor in the BCS controller shall be able to manage remote field interface units thereby expanding its control loop and energy management point capacity. Each BCS controller including associated input/output modules shall have a minimum of 10% spare input and output points of each type installed. The BCS controller shall be supplied with a minimum of 8 hours of battery back-up for the clock operation and memory retention with an automatic battery charger. Provide interface for damper actuators. BCS controller hardware shall provide relay or solid-state isolation on each contact input circuit and each output circuit to prevent high voltage surges from entering the logic circuits.
1. BCS controllers shall be arranged as indicated on the Drawings and installed to allow controllers to share global data. This global data shall include, but not be limited to: time-of-day, outside air temperature and humidity, and electrical meter and demand information. If BCS controllers are not configured in a communication network to share this data, then each BCS controller shall be provided with sensor inputs to implement sequences indicated on the Drawings when operating in a stand-alone mode.
- C. Terminal Unit Controllers:

1. Control of terminal units shall be accomplished by microprocessor-based stand-alone terminal unit controllers utilizing direct digital control. An individual terminal unit controller shall be provided for each terminal unit and shall interface to the BCS. Wireless space temperature sensors are not allowed. Terminal unit controller components shall be furnished to the terminal unit manufacturer for factory mounting and calibration. Terminal unit controller power shall be 24 V AC. Each terminal unit controller shall contain resident programs which are field-selectable for a specific application. Resident programs shall be contained in nonvolatile memory using EEPROM, EPROM, or RAM. Systems that employ volatile (RAM) memory shall provide 72 hour battery back-up for each terminal unit controller. Temperature setpoints for heating and cooling and night setback shall be independent of each other and shall provide a zero energy band between heating and cooling modes.
2. Each terminal unit controller shall be accessible for purposes of control parameter and setpoint adjustment and monitoring from the BCS. An operator's terminal connected to any BCS controller on the network shall have access to all terminal unit controllers.

2.4 COMMUNICATIONS

- A. The BCS communications shall comprise control products, communication media, connectors, repeaters, hubs, and routers. Controller and operator interface communication shall conform to ASHRAE 135-2016. Install new wiring and network devices as required to provide a complete and workable control network. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- B. Each NAC and BCS controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- C. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the web server level and shall enable data to be read from or written to the system.
 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.
 4. System shall support discovery through a Web services connection or shall provide a tool available through the operator interface that will reveal the path/identifier needed to allow a third party Web services device to read data from or write data to any object in the system which supports this service.

2.5 SOFTWARE

A. Web-Based Graphical User Interface (GUI):

1. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer, Google Chrome, Mozilla Firefox, or Safari. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers are not acceptable.
2. The Graphical User Interface (GUI) will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins.
3. Graphic screens shall be capable of supporting Scalable Vector Graphics (SVG).
4. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function are not acceptable.
5. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the GUI (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, are not permitted.
6. Real-time displays: GUIs shall, at a minimum, support the following graphical features and functions:
 - a. Graphic screens shall be capable of being developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be required. In addition to, or in lieu of, a graphic background the GUI shall support the use of scanned pictures.
 - b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.
 - c. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of 6 layers shall be supported.
 - d. Modifying common application objects, such as schedules, calendars, and setpoints shall be accomplished in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
 - e. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
 - f. Adjustments to analog objects, such as setpoints, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No text entry shall be required.
 - g. All Niagara AX native graphics as well as all HTML5 non-native graphics supported by Niagara 4.
7. System configuration: at a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

- a. Create, delete, or modify control strategies.
 - b. Add or delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.
8. On-line help: provide a context sensitive on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for the currently displayed screen. Additional help information shall be available through the use of hypertext. System documentation and help files shall be in HTML format.
 9. Security: each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a specified time. This auto log-off time shall be set per operator password. System security data shall be stored in an encrypted format.
 10. System diagnostics: the system shall automatically monitor the operation of modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
 11. Alarm Console:
 - a. The system shall be provided with a dedicated alarm window or console. This window shall notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the alarm console may be enabled or disabled by the system administrator.
 - b. When the alarm console is enabled, a separate alarm notification window will supersede other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable.
 12. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to set a specific home page for each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 13. Graphic screens on the Web browser client shall support hypertext links to other locations on the internet or on intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
 14. Graphics: the monitor display format shall be organized to permit the output of displays, and/or summaries specified herein, while concurrently displaying the most recent change-of-state occurrence.
 - a. The format shall also include in a dedicated and protected area of the viewing screen, the current user of the monitor, date, time, and program day. The monitor shall output advisories in a dedicated and protected area of the viewing screen and an

appropriate display in the event of control system hardware malfunction or restoration.

- b. Graphic displays for systems and system components shall be provided as indicated in the I/O summaries.
 - 1) The operator shall be capable, upon command entry, of calling for graphic displays of systems or zones.
 - 2) Displays shall contain flow schematics, and schematics of mechanical duct systems, electrical switchgear, electrical distribution systems, fans, dampers, coils, pull stations, smoke detectors, heat detectors, circuit breakers, engine-generator sets, and cooling towers for systems indicated in the I/O summaries to have graphic display.
 - 3) Displays shall include scaled building floor plans with air handling unit and terminal unit temperature control zones identified and space sensors indicated.
 - 4) Displays shall indicate values or status of I/O points associated with that system and those shall be dynamically updated at least once every 10 seconds. Software shall be provided to allow operator modification of graphic displays provided with the system and to allow operator creation and storage of new graphic displays.
 - 5) For each air handling unit provide a tabular graphic summary of that unit and its associated air distribution system. Graphics shall contain, at a minimum, the following information:
 - a) Supply fan's current operating speed and setpoint.
 - b) Manual adjustment of supply fan speed.
 - c) Supply air static pressure and temperature.
 - d) For each associated terminal unit, as appropriate:
 - (1) Minimum, maximum, and current airflow.
 - (2) Current damper position or command.
 - (3) Current associated space temperature.
 - e) A commandable override point to place associated terminal units at maximum airflow.
 - f) A commandable override point to place associated terminal units at minimum airflow.

B. System Tools:

1. System Configuration Tools:

- a. The workstation GUI software shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
- b. A library of control, application, and graphic objects shall be provided to enable the creation of applications and user interface screens. Applications shall be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphical connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by

graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property shall be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays are not acceptable.

c. Programming Methods:

- 1) Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links shall vary in color depending on the type of link, i.e., internal, external, hardware, etc.
- 2) Configuration of each object shall be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.
- 3) The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real-time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
- 4) Programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects are not acceptable.
- 5) The system shall support object duplication within a customer's database. An application, once configured, shall be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2. Library:

- a. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- b. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- c. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the internet) library, available to registered users to provide new or updated objects and applications as they are developed.
- d. Control objects shall conform to the control objects specified in the BACnet specification.
- e. The library shall include applications or objects for the following functions, at a minimum:
 - 1) Scheduling object: the schedule shall conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday and

- temporary scheduling features and a minimum of 10 on/off events per day. Data entry shall be by graphical sliders to speed creation and selection of on-off events.
- 2) Calendar object: the calendar shall conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry shall be by graphical "point-and-click" selection. This object shall be "linkable" to scheduling objects for effective event control.
 - 3) Duty cycling object: provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects shall be created to control equipment at varying intervals.
 - 4) Temperature override object: provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling, etc.) to maintain occupant comfort or for equipment freeze protection.
 - 5) Start-stop time optimization object: provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Object shall also allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of start/stop time object properties based on the previous day's performance.
 - 6) Demand limiting object: provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists shall be specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.
- f. The library shall include control objects for the following functions. Control objects shall conform to the objects as specified in the BACnet specification.
- 1) Analog input object: comply, as a minimum, with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

- 2) Analog output object: comply, as a minimum, with the BACnet standard for data sharing.
- 3) Binary input object: comply, as a minimum, with the BACnet standard for data sharing. Users shall be able to specify either input condition for alarming. This object shall also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. Users shall be able to specify either input condition as the "on" condition.
- 4) Binary output object: comply, as a minimum, with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay shall be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.
- 5) PID control loop object: comply, as a minimum, with the BACnet standard for data sharing. Each individual property shall be adjustable as well as be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
- 6) Comparison object: allow a minimum of 2 analog objects to be compared to select either the highest, lowest, or equality between the 2 linked inputs. Object shall also allow limits to be applied to the output value for alarm generation.
- 7) Math object: allow a minimum of 4 analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Object shall also allow limits to be applied to the output value for alarm generation.
- 8) Custom programming objects: provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object shall provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
- 9) Interlock object: provide an interlock object that provides a means of coordination of objects within a piece of equipment such as air handling units or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) shall be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handling unit is stopped, the interlocked return fan shall also be stopped, the outside air damper shall be closed, and other related objects within the air handling unit shall be inhibited from alarming thereby eliminating nuisance alarms during the off period.
- 10) Temperature override object: provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object shall be linked to the desired binary output object as well as to an analog object for temperature

- monitoring, to cause the override to be enabled. This object shall execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
- 11) Composite object: provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object shall have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.
- g. The object library shall include objects to support the integration of devices connected to the NAC. At a minimum, provide the following as part of the standard library included with the programming software:
- 1) For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
 - 2) For BACnet devices, provide the following objects at a minimum:
 - a) Analog in.
 - b) Analog out.
 - c) Analog value.
 - d) Binary.
 - e) Binary in.
 - f) Binary out.
 - g) Binary value.
 - h) Multistate in.
 - i) Multistate out.
 - j) Multistate value.
 - k) Schedule export.
 - l) Calendar export.
 - m) Trend export.
 - n) Device.
 - 3) For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
 - 4) For BACnet devices, provide the following support at a minimum:
 - a) Segmentation.
 - b) Segmented request.
 - c) Segmented response.
 - d) Application services.
 - e) Read property.
 - f) Read property multiple.
 - g) Write property.
 - h) Who-has.
 - i) I-have.
 - j) Who-is.
 - k) I-am.

- l) Media types.
- m) BACnet IP Annex J.
- n) MS/TP.
- o) BACnet Broadcast Management Device (BBMD) function.
- p) Routing.

C. BCS Software:

1. General: provide global synchronization of BCS controller clocks and global coordination of BCS controller activity. Standard utility software packages shall be contained in memory including self-test diagnostics and on-line memory diagnostics. System displays (hard and soft copy) shall be in plain English. Field selected control and monitoring points shall be capable of being described using operator selected menu penetration techniques. Values shall be described in appropriate units. The system shall have at least 3 user access levels. Menus and screens shall be organized to present orderly information. The system shall perform the following functions:
 - a. Operator communication with any BCS and terminal unit controller including programming and data acquisition.
 - b. Full English operator display, including appropriate engineering units for variable data.
 - c. Power Failure and Automatic Restart:
 - 1) Power failure recovery: when recovering from a failure of the normal power supply, the system shall automatically:
 - a) Initialize the time of day within the real-time operating system.
 - b) Adjust time dependent parameters within the monitoring and control software.
 - c) Automatically restart and output a message indicating that a power failure occurred with the time and date of occurrence. A system restart shall initialize processors and communications, update time programs, and reset equipment to the appropriate operating status for the correct time.
 - d. System displays shall be capable of being randomly configured with any point assigned to any system for display/logging, independent of its hardware location.
 - e. Remote status to allow the operator to display on the monitor any point noting point description and engineering value.
 - f. System function to allow operator to update time and date.
 - g. Upload/download to transfer database to/from disk or diskette storage to/from BCS or terminal unit controller.
 - h. Edit/create database to configure, edit, create or delete database information in whole or in part.
 - i. Database error checking to provide a method of detecting and annunciating discrepancies that would prevent the system from full normal operation.
 - j. Whenever a field point status exceeds preset limits, or there are other indications of system exceptions, alarms, error or failures, there shall be at least the following indications:

- 1) Audible tone: the system shall have an integral audible tone. The audio tone shall be capable of being enabled or disabled on operator command.
 - 2) Display: the alarm point identification shall appear on the monitor and print out along with individual point alarm messages. Upon operator command, alarms resident in the CCU shall be hard copy printed along with individual point alarm messages.
 - 3) Automatic dial out: the system shall automatically initiate calls to up to 4 telephone numbers on a rotating basis. Only those alarms selected by the Owner during BCS training shall initiate automatic dial out features.
2. System programming: controller software and custom programming shall be provided to implement control sequences as indicated on the Drawings. Each BCS controller shall contain mathematic, logic, utility functions and standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:
- a. Math Routines:
 - 1) Basic arithmetic.
 - 2) Binary logic.
 - 3) Relational logic.
 - b. Utility Routines:
 - 1) Process entry and exit.
 - 2) Variable adjustments and output.
 - 3) Alarm indication.
 - 4) Restart.
 - c. Control Routines:
 - 1) Signal compensation.
 - 2) Loop control.
 - 3) Energy conservation.
 - 4) Timed programming.
 - d. Energy Management Routines:
 - 1) Scheduled start-stop and holiday programming.
 - 2) Optimal start-stop.
 - 3) Duty cycling.
 - 4) Demand limiting.
 - 5) Day-night setback.
 - e. Terminal Unit Control:
 - 1) Volume control in response to temperature.
 - 2) Volume flow limits, minimum and maximum.
 - 3) Occupied and unoccupied operation with associated temperature, and volume limits.
 - 4) Occupant temperature adjustment.

- 5) Temperature setpoint override.
 - 6) Occupant override.
 - 7) Global reset of temperature and volume limits.
- f. Project tailored programs: the library of routines available in firmware shall be capable of generating additional programs for specific Project requirements. These should include but not be limited to:
- 1) Supply air temperature control.
 - 2) Variable volume supply fan control.
 - 3) Space temperature control.
 - 4) Fire alarm activated sequences.
 - 5) Totalizing.
 - 6) Event initiated sequences.
3. Each BCS controller shall perform its full control and energy management functions, regardless of the condition of the communications link with other system components. These stand-alone capabilities shall be implemented and shall include, but not be limited to, closed loop control functions (P, PI, PID, incremental, floating) and energy management functions. BCS controllers and terminal unit controllers shall be totally stand-alone and independent of other components of the BCS for control applications specified herein. Failure of other components of the BCS shall in no way inhibit the operation or program execution of BCS controllers and terminal unit controllers.
4. BCS controller control algorithms shall be available and resident in the BCS controller to permit proportional, integral and derivative control modes in any combination to meet the needs of the application. Other control modes, incremental, floating or 2-position, shall be available to adapt to the needs of the Project. Adjustment of control variables shall be available at the BCS controller through the display unit. These adjustments shall include, but not be limited to, proportional gain, integral rate, the velocity and acceleration constants associated with incremental control, and on/off values of 2-position control. Each control loop setpoint and control logic threshold shall be programmed as a variable expressed in the appropriate engineering units and shall be displayable and adjustable through the display unit. Modification of BCS software shall not be required to alter those variables.
5. Software, local variables, and data resident in the BCS controllers shall be resident in nonvolatile memory or shall be down-loadable from the BCS.

D. Energy Management Software:

1. Scheduled start-stop and holiday programs: provide software to start and stop equipment based on the time-of-day for each day-of-week, including holidays. To eliminate power surges and to ensure stable system operation, an operator adjustable time delay shall be provided between consecutive start commands and between consecutive stop commands for electrical loads. Software shall provide for multiple start/stop events scheduled for each output for each day, including holidays.
2. Optimum start-stop program: provide software to start and stop equipment on a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, indoor and outside conditions using prediction software to determine the minimum time of system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end. The program shall automatically modify the calculation constants based on its past performance.

3. Demand limiting program: provide software to shed electrical loads to prevent exceeding an electrical demand peak value (target). The program shall continuously monitor power demand, and with prediction software, calculate a predicted power demand. When the predicted power demand exceeds a preset desired target, the program shall turn off or adjust operation of electrical loads on a prescheduled priority basis to reduce the connected load before the actual peak exceeds the target. The demand limiting program shall provide several priority levels of loads. Loads in the lowest priority level shall be shed before loads in the next higher priority level. Loads shed within a priority level shall be rotated automatically, subject to equipment constraints to avoid any one load from always being shed first. Loads shed in the highest priority level shall be restored before loads in lower priority levels. The demand program shall be compatible with time-of-day metering. The program shall permit a minimum of 6 individually resettable time-of-day demand periods in 24 hours. The start and stop time of each time-of-day demand program shall allow different daily schedules for 3 types of days (weekday, weekend, holiday). A time-of-day metering calendar shall be established by the program which shall define daily time-of-day metering schedules.
 4. Day-night setback program: provide software to limit the rise or drop of space temperature during unoccupied hours. Whenever the space temperature is above (or below for heating) the operator assigned temperature limit, the system shall be enabled until the temperature is within the assigned temperature limit.
 5. Power fail-auto restart: on power failure, the BCS controller shall shutdown without damage to the BCS controller or connected systems, and without loss of programmed information. If power is restored within the time specified herein for battery back-up of BCS controller clock operation, the BCS shall automatically restart, adjust operating parameters according to the proper time of day, and resume full normal operation within no longer than 5 minutes following restoration of power. Each controlled item of equipment 5 hp or greater shall be sequentially restarted or returned to proper operation as appropriate for the time-of-day.
 6. Event initiated sequences: based on programmable values of either digital or analog inputs or outputs, the BCS controller shall be able to open or close any output contacts or combination of contact outputs, and adjust any analog output over its normal range.
 7. Terminal unit controller software: provide software for the management and control of the BCS terminal unit controllers. Software shall allow for operator definition of terminal unit controllers as functional groups; monitoring, alarming and reporting of terminal unit parameters on an individual or group basis; after hours terminal unit operation monitoring and reporting on an individual or group basis; and remote setpoint adjustment of terminal unit parameters on an individual or group basis in response to operator commands or through software interaction.
- E. Trending and reporting: a utility software data file log package shall be provided that analyzes and formats, into English language, a hard copy printout of hardware and software configurations of the system. This package shall be designed to allow the operator to select individual data file logs specified herein. This software package shall be executable via the BCS to allow site hard copy documentation of current data file caused by system modifications and schedule changes.
1. System configuration log: data file logs shall document basic system parameters, individual channel configuration with listing of type of hardware used with its assigned system address, listing of peripheral device (printer and operator terminals) and address with its associated segregation as to function.
 2. Individual point parameter log: this software package shall provide a detailed listing of system points with the following information:

- a. Digital points: point address, assigned engineering units, type of point, listing of which programs the point is used in the system.
 - b. Analog points: point address, engineering units, assigned scale factor, offset, decimal position of value, and a listing of which programs the point is used in the system.
3. System program data file log: provide to document details on individual application programs as listed below:
 - a. Time program log of programs, or selected programs, listing program number and on and off times assigned for each individual day of the week.
 - b. A listing of points grouped by initiating devices causing a change in condition. For example, a listing of points scheduled on by a fixed time schedule.
 - c. Printout listing individual calculation address with its assigned operators and parameters. Also, a listing of other calculation points using its results.
 4. Alarm summary: an alarm summary shall be provided which contains the point status of points in the alarm condition.
 5. Trend log: a program shall be provided which outputs a log on a time interval basis. This program shall provide the operator with the ability to place a minimum of 16 points on trend logs and the ability to assign the trend interval from 1 second to 99 minutes. Adding, changing, or deleting a trend point, assigning the trend log period, or outputting the trend log shall be performed without any loss of change-of-state reporting on the designated hard copy device. Trend log report information shall be listed in vertical columns. A directory of columnar placement shall appear in the heading of the trend log.
 6. Historical data file storage: the system shall provide software to allow operator designation of point values or status to be automatically stored in historical files on the hard disk of the BCS central computer. Software shall allow operator designation of which point data is to be stored, at what frequency it is to be stored, when to start and when to stop storing the data, and shall allow a minimum of 50 points to be assigned to the historical data function at one time.
 7. Field generated reports: the system shall have the capability, as installed, to develop custom management report logs. The software shall be capable of displaying, organizing, and editing the historical data files of point data.

2.6 SENSORS

A. BCS Sensors:

1. Provide sensors, controls, instruments, and control interfaces to meet the performance specified herein. Sensors shall be high quality precision electronic type, selected to be compatible with the BCS controllers and appropriate for the service specified herein. Accuracy values specified herein include sensor, wiring, signal conditioning and display accuracies for overall end-to-end performance. Sensors shall be selected to place the expected value in the middle third of the device's range.
2. Temperature sensors: 100 or 1000 ohm platinum resistance temperature device (RTD), Deutsche Industrial Norms (DIN) 43760, with an average percent change in resistance per degree (α) of 0.00385 ± 0.00002 ohms/ohm/ $^{\circ}$ C, selected for normal range of media sensed with accuracy of $\pm 0.5^{\circ}$ F at 70° F. Sensors used for Btu calculations shall be matched pairs at the calibration point. Temperature sensor stability errors shall not exceed 0.25° F

cumulative over a 5 year period. Air temperature sensing shall be provided by duct insertion type sensors for supply or return duct temperatures and by extended element averaging type for plenum, and coil entering or leaving temperatures. RTD transmitters shall be a 2-wire, loop-powered device, producing a linear 4-20 mA output corresponding to the temperature span of the connected sensor. The output error shall not exceed 0.1% of calibrated span. Transmitters shall include noninteracting offset and span adjustments and RFI shielding and rejection circuitry to prevent disruption from ambient signals. Transmitter drift shall be less than 0.1°F per year.

3. Space temperature sensors: space temperature type with setpoint adjustment range of 45°F to 85°F. Wireless space temperature sensors are not allowed. The setpoint adjustment shall be locked out, overridden, or limited as to time or temperature in software from a central or remote operator's terminal. Precision thermistors may be used in space temperature sensing applications below 200°F. Sensor accuracy over the application range shall be minimum 0.5°F between the range of 32°F to 150°F including sensor error and A/D conversion resolution error. Sensor manufacturer shall utilize 100% screening to verify accuracy. Thermistors shall be pre-aged and inherently stable. Stability error of the thermistor over 5 years shall not exceed 0.25°F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors shall not be used. Space temperature sensors shall include a communications port for local connection of a portable test/terminal device for communications/programming access to the associated BCS controller.

a. Covers:

- 1) Unless otherwise specified herein, space temperature sensors shall have blank cover, visible temperature indicator integral to the sensor, and concealed means of setpoint adjustment.
- 2) Space temperature sensors in patient rooms shall have blank cover and accessible means of setpoint adjustment.

- b. Humidity sensors: bulk polymer type, with self-contained 4-20 mA transmitter and replaceable element. Accuracy shall be $\pm 2\%$ RH in the range of 20% to 90%. The transmitter shall include noninteracting zero and span adjustments with an output error not exceeding 0.1% of calibrated span. Saturation shall not alter calibration. Sensors for space humidity shall have same appearance as space temperature sensors.

- c. Pressure sensors: 2-wire strain gauge type, designed for media sensed for static pressure or differential pressure. The span shall be continuously adjustable from 0% to 125% of the expected full pressure or full flow differential pressure. The zero shall be continuously adjustable on outputs. Transmitters shall produce a 4-20 mA signal with an accuracy of $\pm 1.0\%$ of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding an overrange pressure limit of 300% normal.

- d. Current sensing relays: current sensing relays shall provide an adjustable setpoint normally open contact rated at a minimum of 50 V peak and 0.5 A or 25 VA, noninductive. There shall be a single opening for passage of current carrying conductors. Relays shall be sized for operation at 50% rated current based on the connected load. Voltage isolation shall be a minimum of 600 V.

- e. Filter status: filter status shall be sensed by 4-20 mA input from differential pressure gauges across each filter, as specified in Section 237000, Air Distribution.

- f. Building electrical meter: kilowatt-hour pulses shall be obtained from the building electrical meter. Provide current transformers, pulse initiators and equipment for

interface of signals to the BCS. Components shall provide a minimum of 5 pulses per minute at 75% design load. System shall have separate input point for each kWh meter.

2.7 MATERIALS

A. Actuators:

1. BCS terminal unit actuators: 24 V nonstall spring return type, providing complete modulating control for the full range of damper movement. Actuators shall be de-energized when the damper has reached the operator or system determined position. Actuators shall be supplied to the terminal unit manufacturer for factory mounting and calibration. Actuators shall be removable for servicing without removing the terminal unit. Actuators shall be provided with transformers for proper operation from the terminal unit controller power source.
2. Other actuators: 24 V electric worm-gear type, sized to provide required starting torque and control the driven apparatus smoothly. Higher voltage actuators are acceptable for specific applications where 24 V actuators are not adequate. Provide adjustable end switches for damper open/closed monitoring where required by the control sequences or as specified herein.
 - a. Actuators shall have spring return.
 - b. Actuators for outside air, exhaust air, and other openings to the outside shall have spring return.

B. Thermostats: nonconstant bleed relay or line voltage type and shall have adjustable throttling range with an accuracy of $\pm 1.0^{\circ}\text{F}$. Room type shall have blank cover with thermometer, and accessible concealed means of adjustment. Remote element type shall have accessible adjustment knob.

1. Low limit safeties: elements shall respond to the lowest temperature to which any 12" segment is exposed; minimum length 8'.
2. Averaging type: for use in coil discharge and mixed air locations.
3. Thermostats shall not contain mercury.

C. Thermostat guards: 22 gauge steel with lockable hinged cover and baked enamel finish. corrosion resistant wire mesh with lock.

D. Humidistats: same cover as room thermostats, with an accuracy of $\pm 5\%$.

E. Occupied/unoccupied switches: stainless steel coverplates with red pilot light. Coverplates shall be engraved with "Occupied/Unoccupied". Pilot light shall be on whenever switch is in the occupied position.

F. Manual push buttons: flush-mounted, in NEMA 1 enclosure with pilot light.

G. Temperature regulators, self-contained: adjustable type with enclosed bellows, cadmium-plated spring, indexed spring adjustment guide, top mounted 3.5" diameter temperature indicator, sensing bulb and copper plastic-covered Teflon-covered capillary tubing. Capillary length shall be as required for the installation.

- H. Control dampers: single-blade up to 8" high, multiblade over 8" high; minimum 80% free area based on damper frame outside dimensions.
1. Blades: minimum 16 gauge galvanized steel, or extruded aluminum. Blades shall be airfoil shape.
 - a. Pivot rods: steel, minimum 0.5" diameter or hex, with one rod extended 6" to permit operation of damper from outside the duct.
 - b. Maximum length 42"; maximum width 8".
 - c. At points of contact: interlocking or overlapping edges, and compressible neoprene or extruded vinyl blade seals, and compressible metal side seals designed for temperature of -40°F to 180°F at leakage rate specified herein.
 - d. Type:
 - 1) Opposed blade: for balancing and modulating applications.
 - 2) Parallel blade: for 2-position, and outside and return air mixing applications. For mixing applications, orient dampers to achieve maximum mixing at throttled conditions.
 - e. Maximum damper area per motor: 15 ft².
 2. Leakage when closed: less than 4 cfm/ft² at 1" wg differential static pressure based on a 48" damper width.
 3. Frames: galvanized steel bar minimum 2" wide x 12 gauge for dampers 10" high or less, and 3.5" x 0.875", 16 gauge galvanized roll-formed channel with double-thickness edges or 5" x 1" x 0.125" extruded aluminum channel for 11" high and larger.
 - a. Corner bracing.
 - b. Full size of duct or opening in which installed.
 4. Bearings: synthetic stainless steel sleeve type.
 - a. Thrust bearings: vertically mounted.
 - b. Maximum spacing: 42".
 5. Finish on steel parts: galvanized.
 6. Operating linkage: factory-assembled, concealed in frame out of airstream, steel construction.
- I. Panels: surface type cabinet with hinged front panel and cylinder lock. Panels shall utilize one master key.
- J. Wiring: low voltage control wiring shall be not less than #18 AWG, 600 V plastic covered, color-coded. Line voltage wiring shall be not smaller than #16 AWG, 600 V. Sensor wiring shall be not less than #20 AWG twisted, shielded.
- K. Labels: as specified in Section 230010, HVAC General.
- L. Thermometers:
1. Air: 5" diameter, bimetal type.

- M. Emergency fan shutdown stations: normally closed toggle switches mounted on a panel with a locked, transparent front cover. Panel shall show a system schematic showing each area, and have engraved labels for each switch. Submit detailed shop drawing of panel and labels for approval.
- N. Thermowells: monel, brass, or copper for use in stainless steel for other applications. Thermowells shall have threaded plug and chain, retaining nut, and lagging neck to clear insulation. Inside diameter of insertion neck shall accommodate the element being installed.
- O. Time switches: 7 day electronic programmable microprocessor type, with a temporary override feature for over calling the off position and operating the system without resetting the program, and a 48 hour battery powered carryover for loss of power.
- P. Occupant override timers: 1 hour interval type for overcalling the time switch off position and operating the system on a temporary basis.
- Q. Weather shield enclosures: NEMA 3R rated with transparent cover, sized for the device enclosed.
- R. Airflow measurement systems: provide complete UL listed assemblies to monitor airflow in ductwork and plenums at locations indicated on the Drawings. Each system shall be complete with one or more multipoint measuring probes, airflow sensors and a single microprocessor-based transmitter.
 - 1. Probes: aluminum or stainless steel construction with mounting brackets. Probes shall be supported at both ends.
 - 2. Airflow sensors: designed to operate at velocities of 50 fpm to 5000 fpm, temperatures of -20°F to 140°F, and relative humidities of 0% to 99% (noncondensing). Each sensing point shall independently determine the airflow rate which shall be equally weighted and averaged by the transmitter prior to output.
 - 3. The minimum number of sensors for each assembly shall be as follows:

| <u>Area, (ft²)</u> | <u>No. of Sensors</u> |
|-------------------------------|-----------------------|
| 1 to 4 | 4 |
| 4 to 8 | 6 |
| 8 to 12 | 8 |
| 12 to 16 | 12 |
| >16 | 16 |

- 4. Transmitters: designed to operate at temperatures of -20°F to 120°F and provided with LCD display, 24 V AC power connection, and analog output signal (0-10 V DC or 4-20 mA) for connection to the BCS.
- 5. Accuracy: ±2% of reading over the entire operating airflow range.
- 6. Manufacturer: Ebtron, Fluid Components International, or Tek-Air.

2.8 AUXILIARY EQUIPMENT

- A. Transient surge suppressors: suppressors shall be solid state, operate bidirectionally, and have a turn-on and turn-off time of less than one nanosecond, and shall provide the protection specified herein, either as an internal part of the BCS controller or as a separate component. Suppressor manufacturer shall have available certified test data confirming a fail short failure mode.

1. Communication or Signal Conductor Transient Suppressors:
 - a. Maximum single impulse current conductor-to-conductor or conductor-to-ground: 10000 A, 8 x 20 μ s waveform.
 - b. Pulse life rating: 3000 A, 8 x 20 μ s waveform, 2000 occurrences.
 - c. Maximum clamping voltage at 10000 A, 8 x 20 μ s waveform, with the peak current not to exceed the normal applied voltage by 200%.

PART 3 - EXECUTION

3.1 GENERAL

- A. Where control devices are installed on insulated ductwork, provide standoff brackets or thermowells sized to clear insulation thickness. Provide extended sensing elements, actuator linkages, and other accessories as required.
- B. Wiring and tubing shall be identified with the same numbers and symbols as used on the corrected, approved record diagrams.
- C. Label control apparatus with nameplates or tags bearing the functional designations shown on approved control diagrams.
- D. Where control devices are exposed outside the building, provide weather shield enclosures.

3.2 COMMISSIONING SUPPORT REQUIREMENTS

- A. Prepare a written plan indicating in a step-by-step manner the procedures that will be followed to test, check-out, and adjust the control system prior to beginning functional testing. Keep the Commissioning Authority informed of progress with the Project and of changes to the proposed installation, programming and test plan. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
 1. Step-by-step procedures for testing each type controller after installation, including:
 - a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to load controllers and verifying that they are addressed correctly.
 2. Process of verifying proper hardware and wiring installation.
 3. Process of performing operational checks of each controlled component.
 4. Plan and process for calibrating damper actuators and sensors.
 5. A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 6. A copy of the log and field check-out sheets that will document the process. This log shall include a place for initial and final values read during calibration of each point and clearly indicate when a sensor or controller has passed and is operating within the contract parameters. Notification of any equipment failures shall be documented.

7. A description of the instrumentation required for testing, including a certification of calibration for each test instrument.
 8. Identify which tests and systems should be completed prior to using the control system for test, adjustment, and balance work.
- B. Provide the Commissioning Authority complete system logic diagrams, describing the proposed system programming, with programmed attributes shown. These diagrams shall be updated with field modifications from the start-up, check-out, and prefunctional testing prior to the beginning of the functional testing of the BCS. Provide a copy of each proposed graphical interface screen with interface points shown for the entire system.
- C. Prefunctional tests: verify and document the proper installation, addressing, calibration, programming, operation, and failure mode of BCS control points, sequences, and equipment. Provide a signed and dated certification to the Commissioning Authority and Owner upon completion of the check-out of each controlled device, equipment, and system that installation, set-up, adjustment, calibration, and system programming is complete as specified herein and as indicated on the Drawings, except functional testing. Completed prefunctional documentation of the system verification shall be submitted to the Commissioning Authority for review and approval prior to the functional testing of the BCS or its being used in the testing of other equipment or systems, or other purposes. Copies of final field check-out sheets and trend logs shall be provided to the Commissioning Authority for inclusion in the Commissioning Report.
- D. Functional tests: conduct and document a functional test of the complete installed BCS, as defined in Section 230090, Performance Verification. Functional testing of the BCS may be conducted in phases or sections, as defined by the requirements of the Functional Test, or as approved by the Commissioning Authority. The BCS, or applicable portions of the system, shall have completed functional testing and be approved by the Commissioning Authority before being used for other purposes, such as test and balance measurements, or in support of the functional testing of other systems.
1. Assist in the functional testing of equipment and systems by implementing trend logs and equipment monitoring as specified herein and as required by Section 230090, HVAC Performance Verification.
- E. Meet with the testing, adjusting, and balancing contractor prior to beginning the test, adjustment, and balance process and review the test, adjusting, and balancing plan to determine the capabilities and requirements of the control system in completing the testing, adjusting, and balancing process. Provide the testing, adjusting, and balancing contractor any needed unique instruments for setting terminal units and instruct the testing, adjusting, and balancing contractor personnel in their use. Assist and cooperate with the testing, adjusting, and balancing contractor by providing a qualified technician to operate the controls as required to assist the testing, adjusting, and balancing contractor in performing his work, or alternatively, provide sufficient training for the testing, adjusting, and balancing contractor to operate the system without assistance. Verify the proper operation of affected controls at the completion of the test, adjustment, and balance procedure.
- F. Seasonal Adjustment:
1. Assist the Commissioning Authority with the seasonal adjustment process. During this effort the Commissioning Authority will:

- a. Check and verify the calibration of temperature control devices and thermostats. Test and verify control sequences for proper operation for the season.
- b. Where deficient operation or defective equipment is discovered, provide corrective measures as required by the warranty provisions specified herein.

3.3 BCS

A. BCS Failure Mode:

1. BCS controls and interfaces shall be arranged so that equipment controlled by the BCS operates as indicated on the I/O summaries on failure of the BCS controller for any reason, including logic power supply failure, CPU lock-up, or interposing relay failure. Safety and operational interlocks shall remain in effect.

B. Control sequences for fire alarm system signal responses shall be independent of the BCS controller and its outputs.

C. Modify the existing BCS software to include new systems specified herein. Provide graphic displays for systems and systems components as indicated in the I/O summaries.

D. Transient surge suppressors: install on low voltage signal or communications conductors entering the building from exterior locations, including those conductors from devices mounted on the exterior of the building. In addition, provide AC voltage power transient suppressors for BCS equipment power supplies.

E. BCS Sensors:

1. Liquid temperature sensors: fill sensor wells with thermally conductive material to assure accurate readings.
2. Current sensing relays: fan status shall be sensed by a current sensing relay wired on the load side of each fan. For variable speed fans, the current sensing relay trip setpoint shall be set for the lowest operating speed, as determined by the commissioning process (typically 20%).
3. Proper calibration of sensors shall be demonstrated and documented as part of the commissioning process.
4. Sensor calibration: calibration of sensors shall be included as part of the prefunctional checklists according to the following procedures:
 - a. General: verify that sensors with shielded cable are grounded only at one end.
 - b. Sensors without external transmitters: take a reading with a calibrated test instrument within 6" of the sensor installation and verify the sensor reading is within the specified tolerance. If not, install offset, calibrate, or replace sensor to obtain required accuracy.
 - c. Sensors with external transmitters: disconnect sensor from transmitter input and connect a signal generator in place of sensor. Using manufacturer's data, simulate minimum measured value. Adjust transmitter potentiometer zero until minimum signal is read. Repeat for the maximum measured value and adjust transmitter until maximum signal is read. Reconnect sensor. Make a reading with a calibrated test instrument within 6" of the sensor installation. Verify that the sensor reading is

within the specified tolerance. If not, repeat process until specified accuracy is achieved, or replace the sensor and repeat process.

- d. Paired sensors: for sensor pairs that are used to determine a temperature or pressure difference, calibrate both sensors to a common measurement and verify they are reading within $\pm 0.25^{\circ}\text{F}$ for temperature and within a tolerance equal to $\pm 2\%$ of the sensor reading for pressure.

F. BCS Start-up and Check-out:

1. Provide the services of control technicians at start-up to check-out the system, verify and calibrate sensors and outputs, input data supplied by the Owner, and place the system in operation. Verify proper operation of each item in the sequences of operation, including hardware and software.
2. Check-out each system for control function through the entire sequence. Check actuator travel on dampers for action and extent. Verify that control dampers open and close completely. Check calibration of instruments. Calculate and verify instrument setpoints.
3. Calibration and testing: calibrate sensors and monitoring inputs and verify proper operation of outputs before the system is placed on-line. Check each point within the system by making a comparison between the operator console and field device. BCS control loops, failure modes, interlocks, sequences, energy management programs, and alarms shall be debugged, tested, and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to schedule the acceptance test, provide written documentation of system calibration and certification that the installed complete system has been calibrated, verified, and is ready to begin testing.

G. BCS Acceptance Conditions:

1. Acceptance test: conduct final acceptance test, with the Owner on site, on the complete and total installed and operational system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics, and software.
2. System shall demonstrate the following minimum acceptable levels of performance, within the physical limitations of the controlled equipment:
 - a. Control loops shall maintain stable, nonhunting, nonoscillating control, with minimum overshoot in response to transient and upset conditions.
 - b. Space and air temperatures shall be maintained within $\pm 1^{\circ}\text{F}$ of setpoint.
 - c. Humidity shall be maintained within $\pm 5\%$ RH of setpoint.
 - d. Duct static pressures shall be maintained within $\pm 0.05''$ wg of setpoint.
 - e. Air quantities shall be maintained within $\pm 5\%$ of setpoint.
3. Final system acceptance will be based upon the completion of the following items:
 - a. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failures during a 10 consecutive day period. Obtain receipt from the Owner acknowledging no failures within the test period. Submit a daily log documenting failures.
 - b. Satisfactory completion of functional performance testing.

- c. Satisfactory completion of the record drawings, and operating and maintenance manuals.
 - d. Satisfactory completion of training programs.
4. Upon final acceptance, the warranty period shall begin.

H. BCS Training:

1. Provide the Commissioning Authority with a training plan for review 4 weeks before the planned training.
2. Provide designated Owner personnel training on the control system. The intent is to clearly and completely instruct the Owner on the capabilities of the control system.
3. The training shall be tailored to the needs and skill-level of the trainees.
4. The trainers shall be knowledgeable on the system and its use in buildings. The Owner shall approve the instructor prior to scheduling the training.
5. The standard operating manual for the system and any special training manuals shall be provided for each trainee, with a copy included in each copy of the operation and maintenance manual. In addition, copies of the system technical manual shall be demonstrated during training and a copy included in each copy of the operation and maintenance manuals. Manuals shall include detailed description of the subject matter for each session. The manuals shall cover control sequences and have a definitions section that fully describes relevant words used in the manuals and in software displays.
6. Copies of audio-visual materials used in the training program shall be delivered to the Owner.
7. Provide formal training sessions. Each session shall be conducted by factory-trained personnel:
 - a. Training I: the first training session shall consist of 24 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Provide materials and training for up to 6 persons to be designated by the Owner. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - b. Training II: Building Systems: the second session shall be held on-site for a period of 24 hours of actual hands-on training after the completion of system commissioning. Provide materials and training for up to 6 persons to be designated by the Owner. The session shall include instruction on:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls, and any interface with security and communication systems.
 - 2) Security levels, alarms, system start-up, shut-down, power outage, and restart routines, changing setpoints, and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and setpoints that if changed will adversely affect energy consumption, energy accounting, and procedures for obtaining vendor assistance.
 - 3) Trending and monitoring features (values, change of state, and totalization), including setting up, executing, downloading, viewing both tabular and

- graphically and printing trends. Trainees shall actually set-up trends in the presence of the trainer.
- 4) Every screen shall be completely discussed, allowing time for questions.
 - 5) Use of keypad or plug-in laptop computer at the zone level.
 - 6) Use of remote access to the system via telephone lines or networks.
 - 7) Setting up and changing a terminal unit controller.
- c. Training III: the third training session shall be conducted on-site 6 months after occupancy and consist of 24 hours of training. Provide materials and training for up to 6 persons to be designated by the Owner. The session shall be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.
 - d. Supervisory training: provide a separate training course for supervisory personnel. This training shall briefly cover the material of the operator training session but shall address the more advanced features of the system with emphasis on the energy conservation strategies and reporting capabilities of the system and how to implement them. The training session shall be conducted by factory-trained personnel and shall be a minimum of two 8 hour days, for a total of 16 training hours. Provide materials and training for up to 6 persons to be designated by the Owner.
8. In addition to the specified BCS training, provide technically competent technicians to attend training sessions for systems and equipment that are monitored or otherwise interfaced with the BCS, to discuss the interaction of the control system to the equipment being discussed.
- I. Control System Operation and Maintenance Manual Requirements:
1. In addition to documentation specified elsewhere herein, compile and organize operation and maintenance manuals in labeled 3-ring binders. The manual shall be organized and subdivided with permanently labeled indexed tabs, containing at minimum:
 - a. Full as-built sequence of operations for each piece of equipment.
 - b. Full as-built set of control drawings, including the marking of system components, sensors, and thermostats, and power sources on the as-built floor plans and mechanical drawings, identified with their control system designations.
 - c. Full point list. In addition to the as-built points list for the major equipment identified in the I/O summary, provide a listing of rooms served by BCS terminal controls, with the following information for each room:
 - 1) Floor.
 - 2) Room number.
 - 3) Room name.
 - 4) Air handling unit identification.
 - 5) Reference drawing number.
 - 6) Terminal unit tag identification.
 - 7) Minimum cfm.
 - 8) Maximum cfm.
 - d. Controller/module data shall include specific instructions on how to perform and apply functions, features, and modes specified herein and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents

shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.

- e. Control equipment component submittals and parts lists.
- f. Thermostats, sensors, switches, and timers, including maintenance instructions and sensor calibration requirements and methods by sensor type.
- g. Dampers and damper actuators.
- h. Full as-built documentation of software programming, including commented software program printouts, and a full print out of all schedules and setpoints after testing and acceptance of the system. Provide an electronic copy of programming and database information for this facility.
- i. Warranty requirements.

3.4 THERMOSTATS

- A. Mount space humidity sensors, humidistats, space CO₂ sensors, space temperature sensors, and thermostats at 48" above the floor.
 - 1. Align horizontally with adjacent light switches.
 - 2. Final locations shall be accessible and shall be coordinated with the furniture layout and architectural layout.
 - 3. More than 2 sensors in a single location shall be installed with a common faceplate to minimize wall space.
- B. Remote element type: mount on a vibration free surface 5' above the floor, unless specified herein to be mounted on a control panel. Provide 1 linear foot of element to sense the temperature of each ft² of the coil face. Install in a serpentine arrangement across the entire face of the coil.
- C. Averaging and low limit safety type elements: install in a horizontal sine curve manner to sense temperatures across the entire face of the coil, and support independently from the coil by stainless steel bands or multibulb holders. Provide 1 linear foot of element for each ft² of coil area. Provide 0.5" metallic raceway or 0.375" hard copper rails for support of elements, both top and bottom, for plenum or duct width greater than 36".
- D. Provide guards on thermostats and space temperature sensors in storage rooms and equipment rooms.
- E. Provide insulated bases for thermostats and temperature sensors installed on exterior walls or walls to unconditioned spaces.

3.5 PANELS

- A. Provide a panel for each BCS controller or each system not controlled by the BCS.
- B. Mount the following items in the panels unless otherwise specified herein:
 - 1. BCS controllers.
 - 2. Relays.
 - 3. Switches.
 - 4. 120 V duplex convenience outlet wired from the same circuit as the BCS controller.

5. Wiring and controls.
 6. Terminal blocks.
 7. Gauges showing main pressure, and control pressure of each control or controlled device in the panel.
 8. Remote bulb thermostats and receiver controllers.
 9. Thermometers on panels showing outside, supply, and return air temperatures for air handling units.
- C. Wire controllers, relays, switches, and controls in the control panel to a terminal block. Line voltage and low voltage shall be separated on different terminal blocks with labels indicating voltage. Each sensor or other electrical device shall be wired back to the terminal block in the control panel. Devices in series shall be individually terminated at the terminal block, such that each side of each device is available at the control panel for troubleshooting. In addition to number markings on each conductor, conductor color shall be the same throughout each wiring run. Wiring shall be neatly tied and routed in the control panel. Shielded wiring shall be terminated neatly, with heat shrink tubing placed over the bare end of the shield. Ground conductors over 4" long shall be insulated with tubing.
- D. Provide 6" x 6" trough the width of the control panel, minimum 24" in length, above the control panel to provide an entrance for cabling and tubing into the panel, with 50% spare nipple capacity.
- E. Provide 120 V power wiring for control power in the top right corner of each panel, with disconnects, power supplies, and transformers associated with the panel also located in the top right corner.
- F. Each item in the panel shall be labeled and the panel labeled as to the system or equipment served.
- G. Panels shall be located to avoid conflicts with ductwork, equipment, the work of other trades, and building conditions. Panel locations indicated on the Drawings shall be coordinated prior to installation and adjusted to avoid conflicts.
- 3.6 STATIC PRESSURE SENSORS
- A. Install sensors in the associated air handling unit control panel and use extended sensing lines. Provide taps for calibration purposes.
- 3.7 THERMOMETERS
- A. Mount thermometers in ducts, and equipment in positions adjusted to be accessible for reading. Use angle and adjustable types where straight type would not be readable.
- B. Fill thermometer wells with thermally conductive material.
- 3.8 CONTROL DAMPERS
- A. Refer to Section 237000, Air Distribution, for installation.
- B. For outdoor air damper assemblies, stage the opening of each section to prevent stratification and poor mixing of outside and return air.

3.9 SMOKE DETECTORS

- A. Refer to Section 237000, Air Distribution, for installation.

3.10 WIRING

- A. Materials and installation of wiring and electrical devices shall be in accordance with Division 26.
- B. Control and sensor wiring shall be installed in conduits and shall be separate from AC wiring of any voltage. Conduits to devices in finished spaces shall be concealed.
- C. Exposed control and sensor wiring shall be installed in conduits and shall be separate from power wiring. Plenum rated cable may be used in concealed spaces if run parallel to structural grid and supported by cable trays or tie wraps, and identified in a manner consistent with the documentation of the system every 30'. Conduits to devices in finished spaces shall be concealed.
- D. Provide transformers or filters for operation of automatic temperature controls from building power circuits. Each BCS controller shall be served by a dedicated transformer, and no more than 10 terminal unit controllers shall be served by a single transformer.
- E. Provide relays, transformers, fuses and interlock wiring as required to accomplish the sequences indicated on the Drawings.
- F. Wiring for emergency fan shutdown stations shall be separate from control and sensor wiring and devices.
- G. See Division 26 for 120 V, 20 A electrical branch circuits designated for control power, terminated in junction boxes. Provide power wiring from the designated junction boxes through control power transformers to BCS controllers, terminal unit controllers, smoke dampers, flow measuring devices, and other power consuming control devices.
- H. See Division 26 for spare branch circuit breakers for control power in 120 V/208 V electrical panel boards. Provide power wiring from electrical branch panelboards through control power transformers to BCS controllers, terminal unit controllers, smoke dampers, flow measuring devices, and other power consuming control devices.
- I. Provide data outlets and associated low voltage cabling for each NAC and BCS controller as required. See Division 27 for communications cabling and outlet requirements. Coordinate the installation of new data outlets with the Owner's Information Technology staff.
- J. Power for terminal unit controllers and smoke dampers shall be distributed at 24 V. For terminal units containing fans or electric heat, control power may be obtained from a control power transformer furnished with the terminal unit.
- K. Branch circuit wiring and conduit furnished under this Section for control equipment power shall be separate from other power wiring. No more than 2 BCS controller installations shall operate from a single 120 V branch circuit.
- L. Low voltage control and sensor wiring shall be continuous without splicing.

3.11 AIR PRESSURE GAUGES

- A. Install a gauge on each controlled device except room thermostats. Gauges may be mounted in or on the control panel if the controlled device is within sight from the panel.
- B. On positive positioning devices, provide gauges for both pilot input and actuator signals.

3.12 AIRFLOW MEASUREMENT SYSTEMS

- A. Install in straight duct sections, in accordance with manufacturer's recommendations and minimum straight duct length requirements.
- B. Manufacturer shall provide start-up services, and demonstration testing for the Owner to verify the accuracy of each system, and shall submit a certificate indicating same.

3.13 SEQUENCES

- A. As indicated on the Drawings.

END OF SECTION 230923

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SECTION 230923.23 - PRESSURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Air-pressure sensors.

- B. Related Requirements:

- 1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

- A. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:

- 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - 3. Product description with complete technical data, performance curves, and product specification sheets.
 - 4. Installation instructions, including factors affecting performance.

- B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
 - a. If instrument alone cannot comply with requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.
2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument-installed location shall dictate following NEMA 250 enclosure requirements:
 - a. Outdoors, Unprotected: Type 4.
 - b. Indoors, Heated and Air-Conditioned: Type 1.
 - c. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
 - d. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
 - e. .

2.2 AIR-PRESSURE SENSORS

A. Duct Insertion Static Pressure Sensor:

1. 2-wire strain gauge type, designed for media sensed for static pressure or differential pressure. The span shall be continuously adjustable from 0% to 125% of the expected full pressure or full flow differential pressure. The zero shall be continuously adjustable on

outputs. Transmitters shall produce a 4-20 mA signal with an accuracy of $\pm 1.0\%$ of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding an overrange pressure limit of 300% normal.

2. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MAMAC Systems, Inc.
3. Sensor probe with two opposing orifices designed to reduce error-associated air velocity.
4. Sensor insertion length shall be 4 inches.
5. Construct sensor of 6061-T6 aluminum alloy.
6. Connection: Threaded, NPS 1/8 swivel fitting for connection to copper tubing or NPS 1/4 barbed fitting for connection to polyethylene tubing.
7. Sensor probe attached to a mounting flange with neoprene gasket and two holes for fasteners.
8. Mounting flange shall suitable for flat oval, rectangular, and round duct configurations.
9. Pressure Rating: 10 psig.

B. Outdoor Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Air Monitor Corporation.
2. Sensor with no moving parts.
3. Operation not affected and impaired by rain and snow.
4. Sensing plates constructed of 0.1406-inch Type 316 stainless steel.
5. Accuracy within:
 - a. 1 percent of the actual outdoor atmospheric pressure when subjected to varying horizontal radial wind velocities up to 40 mph.
 - b. 2 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 30 degrees to horizontal.
 - c. 3 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 60 degrees to horizontal.
 - d. Threaded, NPS 2 connection.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
- C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install products level, plumb, parallel, and perpendicular with building construction.
- B. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- C. Fastening Hardware:
 - 1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- E. Corrosive Environments:
 - 1. Use products that are suitable for environment to which they are subjected.
 - 2. If possible, avoid or limit use of materials in corrosive environments.
 - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
 - 4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRICAL POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 PRESSURE INSTRUMENT INSTALLATION

- A. Mounting Location:
 - 1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
 - 2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
 - 3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
 - 4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
- B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.
- C. Duct Pressure Sensors:
 - 1. Install sensors using manufacturer's recommended upstream and downstream distances.
 - 2. Install mounting hardware and gaskets to make sensor installation airtight.
 - 3. Route tubing from the sensor to transmitter.
 - 4. Use compression fittings at terminations.
 - 5. Install sensor in accordance with manufacturer's instructions.
 - 6. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.
- D. Outdoor Pressure Sensors:
 - 1. Install roof-mounted sensor in least-noticeable location and as far away from exterior walls as possible.
 - 2. Locate wall-mounted sensor in an inconspicuous location.
 - 3. Submit sensor location for approval before installation.

4. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
5. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
6. Install sensor signal pipe with dirt leg and drain valve below roof penetration.
7. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.
8. Connect roof-mounted signal pipe exposed to outdoors to building grounding system.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with instrument identification.

3.6 CHECKOUT PROCEDURES

- A. Check out installed products before continuity tests, leak tests, and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
 3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
 4. Equipment and procedures used for calibration shall comply with instrument manufacturer's recommendations.
 5. Provide diagnostic and test equipment for calibration and adjustment.
 6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
 7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
 8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.

9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 230923.23

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SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Joining materials.
4. Manual gas shutoff valves.
5. Service meters.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars supports.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "Identification of Plumbing Piping and Equipment."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with the International Fuel Gas Code.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
5. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Baker Hughes Company.
 - 2) Smith-Blair, a Xylem brand.
 - b. Steel flanges and tube with epoxy finish.
 - c. NBR seals.
 - d. Steel bolts, washers, and nuts.
 - e. Coupling is to be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - f. Steel body couplings installed underground on plastic pipe are to be factory equipped with anode.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Corrugated, stainless steel tubing with polymer coating.
3. Operating-Pressure Rating: 0.5 psig.
4. End Fittings: Zinc-coated steel.
5. Threaded Ends: Comply with ASME B1.20.1.
6. Maximum Length: 72 inches.

B. Weatherproof Vent Cap:

1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

2.5 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig .
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig .
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 4. Service Mark: Initials "WOG" permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. BrassCraft Manufacturing Co.; a Masco company.
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. BrassCraft Manufacturing Co.; a Masco company.
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo.
 - c. Lee Brass Company.
 2. Body: Bronze, complying with ASTM B584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping in accordance with the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

3.3 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- C. Copper Tubing with Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- D. Install fittings for changes in direction and branch connections.
- E. Install pressure gauge upstream and downstream from each service regulator. Pressure gauges are specified in Section 230519 "Meters and Gauges for HVAC Piping."

3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- 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. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
 - 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

- a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Section 230519 "Meters and Gauges for HVAC Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 INSTALLATION OF SERVICE-METER ASSEMBLIES

- A. Install service-meter assemblies aboveground , on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 INSTALLATION OF VALVES

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.
- F. Do not install valves in return-air plenums.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.

- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for steel piping , with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for corrugated stainless-steel tubing, 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.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.9 PIPING CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.
- C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.10 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000 psig , 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.11 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test, inspect, and purge natural gas in accordance with the International Fuel Gas Code and authorities having jurisdiction.
2. Natural-gas piping will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

3.12 DEMONSTRATION

3.13 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. -temper copper tube with wrought-copper fittings and brazed joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping NPS1 and smaller is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping is to be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.15 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, -port, bronze ball valves with bronze trim.

3. Bronze plug valve.

B. Valves in branch piping for single appliance are to be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, -port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 231123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Sealants and gaskets.
6. Hangers and supports.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.4 ACTION SUBMITTALS

- A. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work. Minimum 1/4" = 1'-0" scale.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

1.6 QUALITY ASSURANCE

- A. Air conditioning systems shall conform to the following:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are outside dimensions including lining and 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.
 - 2. For ducts exposed to weather, construct of stainless steel indicated by manufacturer to be suitable for outdoor installation.
- 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."

- 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. For ducts exposed to weather, construct of stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate 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."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. 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."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. 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 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
1. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - a. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - b. For ducts exposed to weather, construct outer duct of stainless steel indicated by manufacturer to be suitable for outdoor installation.
 2. 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."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 3. 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."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 4. 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."
- B. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. 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. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. 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.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- B. Strap and Rod Sizes: 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."
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts 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 and equipment 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. Install fire , combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. 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."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include single-thickness turning vanes.
 - a. Vanes shall be parallel to airflow.
 - b. Vanes exceeding the maximum unsupported length defined by SMACNA shall be divided into multiple sections with intermediate vane rails or shall be braced with tie rods spanning perpendicularly across the leading edges of the vanes. The tie rods shall be welded to the leading edge of each vane.
 - 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.
- N. 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. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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 stainless steel.
2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.4 DUCT SEALING

- A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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.
1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- 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.
- G. Support ductwork and equipment associated with smoke control systems directly from fire resistant rated structural elements of the building.

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 primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.
 - 2. The first 20' of rectangular supply and return ductwork outside the HVAC room shall be constructed of 16-gauge sheet metal with a 6" wg static pressure classification for ductwork and transverse joints. The test pressure for duct leakage testing specified in 23 00 95, Testing, Adjusting and Balancing may be equal to that used for downstream ductwork.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2- inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 16.

- d. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4- inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3- inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. 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: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 3. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 3- inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- 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: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. Ducts Connected to Air-Handling Units or Energy Recovery Units:
 - a. Pressure Class: Positive or negative 2- inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

- c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.

- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum.

- F. Double-Wall Duct Interstitial Insulation:
 - 1. Supply-Air Ducts: 2 inch(es) thick.
 - 2. Return-Air Ducts: 2 inch(es) thick.

- G. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

- H. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Smoke dampers.
5. Combination fire and smoke dampers.
6. Duct silencers.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Duct accessory hardware.

- B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
4. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

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

1. For duct silencers, include pressure drop, dynamic insertion loss data, and self-generated noise data.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with 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.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 polished finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming and Ventilating (AWV); Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - 4. Safe Air - Dowco.

- B. Description: Gravity balanced, heavy duty type.
- C. Maximum System Pressure: Equal to pressure class of the duct.
- D. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- E. Blades: Multiple single-piece blades, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Extruded vinyl, mechanically locked.
- H. Blade Axles:
 - 1. Material: Galvanized steel.
 - 2. Diameter: 0.20 inch.
- I. Tie Bars and Brackets: Galvanized steel.
- J. Return Spring: Adjustable tension.
- K. Bearings: Steel ball or synthetic pivot bushings.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gauge minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 4. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Single blade up to 8 inches high.

- b. Opposed-blade design over 8 inches high.
 - c. Stiffen damper blades for stability.
 - d. Galvanized -steel, 0.064 inch thick.
 5. Blade Axles: Galvanized steel.
 6. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 7. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 1. Standard leakage rating, with linkage outside airstream.
 2. Suitable for horizontal or vertical applications.
 3. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 4. Blades:
 - a. Single blade up to 8 inches high.
 - b. Opposed-blade design over 8 inches high.
 - c. Stiffen damper blades for stability.
 5. Blade Axles: Galvanized steel.
 6. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 7. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
 1. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 2. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

- A. Refer to Section 230923.12 Control Dampers.

2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. NCA Manufacturing, Inc.; Metal Industries, Inc.
 3. Prefco.
 4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 5. Safe Air - Dowco.
- B. Type: dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours, except where 3-hour rating is indicated on the Drawings.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream. Fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
1. Dampers in round or flat oval ductwork shall be Type C.
 2. Dampers in rectangular ductwork with minimum dimension 30 inches and larger shall be multiblade type with airfoil shaped blades.
 3. Dampers in rectangular ductwork with minimum dimension less than 30 inches shall be as follows:
 - a. Dampers in return air openings, in security walls, shall be Type A.
 - b. For ductwork with a static pressure rating of 2-inch wg or less: Dampers with a minimum dimension of 18 inches or smaller shall be Type B, and those with a minimum dimension of 19 inches and larger shall be Type A.
 - c. For ductwork with a static pressure rating greater than 2" wg, dampers shall be Type C.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, galvanized sheet steel; gauge in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links, except where higher temperature is indicated on the Drawings.

2.7 CEILING RADIATION DAMPERS

- A. General Requirements:
1. Labeled according to UL 555C by an NRTL.

2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- B. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- C. Blades: Galvanized sheet steel with refractory insulation.
- D. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links, except where higher temperature is indicated on the Drawings.
- E. Fire Rating: Same as ceiling in which the device is installed.

2.8 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance; MESTEK, Inc.
 2. Greenheck Fan Corporation.
 3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 4. Safe Air - Dowco.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Frame: Hat-shaped, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange; gauge in accordance with UL listing.
- D. Blades: Roll-formed, horizontal, galvanized sheet steel; gauge in accordance with UL listing.
- E. Leakage: Class II.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application; gauge in accordance with UL listing.
- H. Damper Motors: or two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or

- adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 7. Electrical Connection: 24 V .
- J. Accessories:
1. Auxiliary switches for position indication.
 2. Momentary test switch, damper mounted.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance; MESTEK, Inc.
 2. Greenheck Fan Corporation.
 3. NCA Manufacturing, Inc.; Metal Industries, Inc.
 4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 5. Safe Air - Dowco.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours, except where 3-hour rating is indicated on the Drawings.
- E. Frame: Hat-shaped, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange; gauge in accordance with UL listing.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links , except where higher temperature is indicated on the Drawings.
- G. Blades: Roll-formed, horizontal, overlapping galvanized sheet steel; gauge in accordance with UL listing.
- H. Leakage: Class II .
- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application; gauge in accordance with UL listing.
- K. Master control panel for use in dynamic smoke-management systems.
- L. Damper Motors: two-position action.

- M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 7. Electrical Connection: 24 V.
- N. Accessories:
1. Auxiliary switches for position indication.
 2. Momentary test switch, damper mounted.

2.10 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dynasonics.
 2. FläktGroup.
 3. IAC Acoustics; a division of Sound Seal.
 4. Price Industries.
 5. Vibro-Acoustics.
- B. General Requirements:
1. Factory fabricated.
 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Shape:
1. Rectangular straight with splitters or baffles.

2. Round straight with center bodies or pods.
 3. Rectangular elbow with splitters or baffles.
 4. Round elbow with center bodies or pods.
 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel.
- E. Round Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A653/A653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- H. Principal Sound-Absorbing Mechanism:
1. See schedule.
- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Lock formed and sealed.
 2. Flanged connections for all pressure classes above 2" or below -2".
 3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 4. Reinforcement: Cross or trapeze angles for rigid suspension.
- J. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.
- K. Source Quality Control: Test according to ASTM E477.
1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 1000-fpm face velocity.
 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- 2.11 REMOTE DAMPER OPERATORS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. METALAIRE, Inc.
 2. United Enertech Corp.
 3. Young Regulator Company.

- B. Description: Cable system designed for remote manual damper adjustment.
- C. Cable: Stainless steel .
- D. Wall-Box Mounting: Surface.
- E. Wall-Box Cover-Plate Material: Stainless steel.

2.12 DUCT-MOUNTED ACCESS PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc; a DMI company.
 - 2. Duro Dyne Inc.
 - 3. McGill AirFlow LLC.
 - 4. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Ductmate Industries, Inc; a DMI company.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.14 FLEXIBLE CONNECTORS AND THRUST RESTRAINTS

- A. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

2.15 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Provide standoff brackets, sized to clear the insulation thickness, for damper quadrants or actuators installed on insulated ductwork.

- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers according to UL listing.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. Upstream from turning vanes.
 - 8. Upstream or downstream from duct silencers.
 - 9. Control devices requiring inspection.
 - 10. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
- M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors and thrust restraints to connect ducts to equipment as required by Section 230548 "Vibration and Seismic Control for HVAC" and as shown in Drawing General Notes, Plans, and/or Details.
- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

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SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- B. 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. Thermaflex; a Flex-Tek Group company.
- B. Insulated, Flexible Duct: UL 181, Class 1, polyethylene fabric supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-Value: R6 .

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect flexible ducts to metal ducts with draw bands with duct tape.
- D. Install duct test holes where required for testing and balancing purposes.
- E. Installation:
1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- F. Supporting Flexible Ducts:
1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.

2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

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SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Square in-line centrifugal fans.
 - 2. Tubular in-line centrifugal fans.
 - 3. Utility set fans.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified fan sound-power ratings.
 - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 6. Material thickness and finishes, including color charts.
 - 7. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fan room layout and relationships between components and adjacent structural and mechanical elements, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in normal operation, emergency operation, and maintenance manuals with replacement parts listing.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 SQUARE IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, undefined:
1. Acme Engineering & Manufacturing Corp.
 2. Aerovent; a division of Twin City Fan Companies, Ltd.
 3. American Coolair Corporation.
 4. Carnes Company.
 5. Greenheck Fan Corporation.
 6. Hartzell Fan Incorporated.
 7. JencoFan.
 8. Loren Cook Company.
 9. PennBarry.
- B. Description: Square in-line centrifugal fans.
- C. Housing:
1. Housing Material: Reinforced steel.
 2. Housing Coating: None.
 3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Drive Units: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

G. Motor Enclosure: Open, dripproof.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Companion Flanges: For inlet and outlet duct connections.

2.3 TUBULAR IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. American Coolair Corporation.
4. Carnes Company.
5. Greenheck Fan Corporation.
6. Hartzell Fan Incorporated.
7. JencoFan.
8. Loren Cook Company.
9. New York Blower Company (The).
10. PennBarry.

B. Description: Tubular in-line centrifugal fans.

C. Housing:

1. Housing Material: Reinforced steel.
2. Housing Coating: None.
3. Housing Construction: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Drive Units: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Steel or Aluminum, airfoil blades welded to aluminum hub.

G. Motor Enclosure: Open, dripproof.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Companion Flanges: For inlet and outlet duct connections.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

2.5 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Compliance: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311 and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify fans according to AMCA 99.

PART 3 - EXECUTION

3.1 INSTALLATION OF CENTRIFUGAL HVAC FANS

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
 - 1. Install floor- or roof-mounted centrifugal fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
 - 2. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
 - 3. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

- E. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.
- F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.
- G. Install units with clearances for service and maintenance.
- H. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories.
- B. Install ducts adjacent to fans to allow service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that there is adequate maintenance and access space.
 - 4. Verify that cleaning and adjusting are complete.

5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 6. Adjust belt tension.
 7. Adjust damper linkages for proper damper operation.
 8. Verify lubrication for bearings and other moving parts.
 9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 10. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Modulating, single-duct air terminal units.
 - 2. Critical environment control valve.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, undefined:
 - 1. Carnes Company.
 - 2. Carrier Corporation; a unit of United Technologies Corp.

3. ENVIRO-TEC; by Johnson Controls, Inc.
 4. Krueger.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Price Industries.
 8. Titus.
 9. Trane.
 10. Tuttle & Bailey.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch- thick galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- E. Attenuator Section: 0.032-inch aluminum sheet.
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware. Provide electric-resistance heating coils for air terminal units scheduled on Drawings.
1. SCR controlled.
 2. Access door interlocked disconnect switch.
 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
 4. Nickel chrome 80/20 heating elements.
 5. Airflow switch for proof of airflow.
 6. Fan interlock contacts.
 7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 8. Pneumatic-electric switches and relays.

9. Magnetic contactor for each step of control (for three-phase coils).

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.2 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7. Comply with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.3 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.4 PIPING CONNECTIONS

- A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

3.5 DUCTWORK CONNECTIONS

- A. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.

3.6 ELECTRICAL CONNECTIONS

- A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.7 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.8 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

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

1. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 2. Nailor Industries Inc.
 3. Price Industries Limited.
 4. Titus: brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, color selected by Architect.
- E. Face Size: 24 by 24 inches 12 by 12 inches.
- F. Face Style: Plaque.
- G. Mounting: Surface T-bar Snap in.
- H. Pattern: Fixed.
- I. Dampers: Radial opposed blade.

2.2 PERFORATED DIFFUSERS

- 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. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 2. Nailor Industries Inc.
 3. Price Industries Limited.
 4. Titus: brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel backpan and pattern controllers, with aluminum face.
- D. Finish: Baked enamel, white Anodized aluminum.
- E. Face Size: 12 by 12 inches 24 by 24 inches [**36 by 24 inches**].
- F. Duct Inlet: Round.
- G. Face Style: Flush.
- H. Mounting: Surface T-bar Snap in.
- I. Pattern Controller: Four louvered deflector patches.
- J. Dampers: Opposed blade Radial opposed blade Butterfly Combination damper and grid Combination volume and fire.

2.3 LOUVER FACE DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 2. Nailor Industries Inc.
 3. Price Industries Limited.
 4. Titus: brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Aluminum.
- D. Finish: Baked enamel, white.
- E. Mounting: Surface Surface with beveled frame T-bar.
- F. Pattern: core style.
- G. Dampers: Combination damper and grid.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Adjustable blade face registers and grilles.
- 2. Fixed face registers and grilles.

- B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
- 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
- 3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
- 4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.3 ACTION SUBMITTALS

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

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
- 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 REGISTERS

- A. Adjustable Blade Face Register:

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

- a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus; brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
 3. Finish:
 4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
 5. Core Construction: Integral.
 6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
 7. Frame: 1 inch wide.
 8. Damper Type: Adjustable opposed blade.
 9. Accessories:
 - a. Front -blade gang operator.

B. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus: brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: .
4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Damper Type: Multishutter.
8. Accessory: Filter.

2.2 GRILLES

A. Adjustable Blade Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus: brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: .
4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
5. Core Construction: Integral.

6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting Frame:
9. Mounting:
10. Accessories:
 - a. Front -blade gang operator.

B. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus: brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish:
4. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting Frame:
8. Mounting:
9. Accessory: Filter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 233713.43 - SECURITY REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes security registers and grilles.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
 - 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
 - 3. Section 233713.23 "Registers and Grilles" for registers and grilles.
 - 4. Section 233716 "Fabric Air Diffuser Devices" for continuous tubular diffusers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 SECURITY REGISTERS

- A. Security Register:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.

- d. Titus: brand of Johnson Controls International plc, Global Products.
2. Security Level: Maximum.
3. Application: Ducted return.
4. Material: Aluminum.
5. Material Thickness: 0.19 inch.
6. Finish: Baked enamel, color selected by Architect.
7. Face Arrangement:
 - a. Shape: Rectangular.
 - b. Design: Fixed bar Perforated Lattice.
 - c. Frame: Yes.
 - d. Deflection: Zero 38 degrees.
 - e. Core: Louvered.
 - f. 3/16-inch- thick, front lattice plate with 2-by-2-inch- square holes and 1-inch frets, 0.135-inch wire mesh, and 1/4-inch- thick backer plate.
 - g. 3/16-inch- thick, perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
 - h. 1-1/2-inch bars and mandrel tubes and rods with 15-degree deflection in 1-1/4-by-1-1/4-by-3/16-inch angle border.
 - i. 1-3/8-inch bars and double mandrel tubes with 15-degree deflection in 1-3/4-inch angle border.
8. Damper Operation: None.
9. Damper Type: Adjustable opposed blade.
10. Wall Sleeve: Mechanically fastened to border.
11. Mounting: 1-by-1-by-3/16-inch retaining angle frame.

2.2 SECURITY GRILLES

A. Security Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus: brand of Johnson Controls International plc, Global Products.
2. Security Level: Maximum.
3. Application: Ducted return.
4. Material: Aluminum.
5. Material Thickness: 0.19 inch.
6. Finish: Baked enamel, color selected by Architect.
7. Face Arrangement:
 - a. Shape: Rectangular.
 - b. Design: Perforated.
 - c. Frame: Yes.

- d. Deflection: 38 degrees.
 - e. 3/16-inch- thick, front lattice plate with 2-by-2-inch- square holes and 1-inch frets, 0.135-inch wire mesh, and 1/4-inch- thick backer plate.
 - f. 3/16-inch- thick perforated faceplate with 5/16-inch- diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
 - g. 1-1/2-inch bars and mandrel tubes and rods with 15-degree deflection in 1-1/4-by-1-1/4-by-3/16-inch angle border.
 - h. 1-3/8-inch bars and double mandrel tubes with 15-degree deflection in 1-3/4-inch angle border.
- 8. Wall Sleeve: 3/16 inch welded to face Mechanically fastened to border.
 - 9. Mounting: 1-by-1-by-3/16-inch retaining angle frame.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.43

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SECTION 237343.16 - OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes outdoor, semi-custom air-handling units that are factory assembled using multiple section components, including:
 - 1. Unit casings.
 - 2. Fan, drive, and motor section.
 - 3. Coil section.
 - 4. Air filtration section.
 - 5. Dampers.
 - 6. Intake and relief air openings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Include unit dimensions and weight.
 - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 - 5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
 - 6. Include certified coil-performance ratings with system operating conditions indicated.
 - 7. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each outdoor, semi-custom air-handling unit.
 - 1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of outdoor, semi-custom air-handling units, as well as procedure and diagrams.
4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: See Section 013500 Coordination Model.
- B. Source quality-control reports.
- C. Startup service reports.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: One set(s) for each air-handling unit.
 2. Gaskets: One set(s) for each access door.
 3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Entire Unit: Manufacturer's standard but not less than one year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. Structural Performance:
 - 1. Casing Panels: Self-supporting and capable of withstanding positive/negative 8-inch wg internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.
 - 2. Floor and Roof Panels: Self-supporting and capable of withstanding 300-lb static load at midspan, without exceeding a midpoint deflection of 0.0042 inch/inch.
- D. Casing Leakage Performance: ASHRAE 111, Class 6 Leakage or better at plus or minus 8-inch wg .

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Global Corporation.
 - 2. Daikin Applied.
 - 3. Dunham-Bush, Inc.
 - 4. Temtrol; A Nortek Air Solutions Company.
 - 5. Trane.
 - 6. USA Coil & Air.
 - 7. YORK: brand of Johnson Controls International plc, Building Solutions North America.
- B. Source Limitations: Obtain from single source from single manufacturer.

2.3 UNIT CASINGS

- A. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.
- B. Base Rail:
 - 1. Material: Galvanized steel.
 - 2. Height: 6 inches.
- C. Casing Joints: Hermetically sealed at each corner and around entire perimeter.
- D. Double-Wall Construction:
 - 1. Outside Casing Wall:
 - a. Material, Galvanized Steel: Minimum 14 gauge thick.
 - b. Factory Finish: Provide Pre-painted 3000 hr Salt Spray ASTM B-117.
 - 2. Inside Casing Wall:

- a. Material, Galvanized Steel: Solid, minimum 22 gauge thick.
 - b. Material, Stainless Steel: Solid, minimum 22 gauge thick.
 - c. Antimicrobial Coating: Applied during the manufacturing process. .
- E. Floor Plate:
1. Material:
 - a. Galvanized steel, minimum 18 gauge thick.
 - b. Stainless steel, minimum 18 gauge thick.
 2. Antimicrobial Coating: Applied during the manufacturing process. .
- F. Roof: Cross-broken and pitched with "C" caps over joints to provide watertight seal.
- G. Piping Vestibule: Insulated with same insulation and thickness as casing, 24 inches deep by full width of piping connections.
- H. Casing Insulation:
1. Materials: injected polyurethane foam insulation.
 2. Casing Panel R-Value: Minimum R-13.
 3. Insulation Thickness: 2 inches.
 4. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
- I. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- J. Static-Pressure Classifications:
1. For Unit Sections Upstream of Fans: Minus 6-inch wg .
 2. For Unit Sections Downstream and Including Fans: 6-inch wg .
- K. Panels, Doors, and Windows:
1. Panels:
 - a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
 - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches.
 2. Doors:
 - a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

- b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches.
 - 3. Windows:
 - a. Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.
 - b. Size: Minimum 6 inches, square or round.
 - 4. Locations and Applications:
 - a. Fan Section: Doors.
 - b. Coil Section: Doors.
 - c. Access Section: Doors.
 - d. Access Sections Immediately Upstream and Downstream of Coil Sections: Doors.
 - e. Damper Section: Doors.
 - f. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - g. Access Sections Immediately Upstream and Downstream of Filter Sections: Doors.
 - h. Mixing Section: Doors.
 - i. Humidifier Section: Doors.
 - 5. Service Lights: LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.
 - a. Locations: Each section accessed with door or panel.
 - 6. Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.
 - a. Locations: Fan section.
- L. Condensate Drain Pans:
- 1. Location: Each type of cooling coil.
 - 2. Construction:
 - a. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - 3. Drain Connection:
 - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

- b. Minimum Connection Size: NPS 1.
 - 4. Slope: Minimum 0.125-in./ft. slope , to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - 5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
 - 6. Width: Entire width of water producing device.
 - 7. Depth: A minimum of 2 inches deep.
 - 8. Formed sections.
 - 9. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
 - 10. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- M. Control Wiring
- 1. Manufacturer shall run wiring inside unit for controls components and terminate with a terminal strip for future installation of sensors and connection to DDC system by controls contractor. Coordinate with Controls Drawings.

2.4 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.
 - 1. Shafts: With field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway.
 - 2. Shaft Bearings:
 - a. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an L-10 rated life of 80,000 hours according to ABMA 9.
 - b. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and two-piece, cast-iron housing with grease lines extended to outside unit and an L-10 rated life of 80,000 hours according to ABMA 11.
 - c. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit and an L-10 rated life of 80,000 .
 - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
5. Plenum Fan Arrays: Contained as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide backdraft dampers at each fan to prevent short circuiting of flow if one fan is not operating.
6. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
7. Shaft Lubrication Lines: Extended to a location outside the casing.

C. Drive, Direct: Factory-mounted, direct drive.

D. Motors:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Enclosure Type: open drip proof .

1. Efficiency: Premium efficient as defined in NEMA MG 1.
2. Motor Pulleys: Adjustable pitch for use with 5 -hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
4. Provide factory-installed shaft grounding rings for motors designed with variable frequency drives.
5. Mount unit-mounted disconnect switches on exterior of unit.

F. Comply with Section 262923 "Variable-Frequency Motor Controllers."

2.5 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with AHRI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.

B. Cooling Coils:

1. Refrigerant Coil:
 - a. Tubes: .

- b. Fins:
 - 1) Material: Aluminum.
 - 2) Fin Spacing: Maximum 8 fins per inch.
- c. Fin and Tube Joints: Mechanical bond.
- d. Headers: Seamless-copper headers with brazed connections.
- e. Frames: Stainless steel.
- f. Coatings:
- g. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
 - 1) Working Pressure: Minimum 300 psig.

2.6 AIR FILTRATION SECTION

- A. High-efficiency particulate air (HEPA) filtration is specified in Section 234133 "High-Efficiency Particulate Air Filtration."
- B. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
- C. Front- or Back-Access Filter Mounting Frames:
 - 1. Particulate Air Filter Frames: Galvanized-steel framing members with access for filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
 - a. Prefilters: Incorporate a separate 2-inch- thick track with same access as the primary filter.
 - b. Sealing: Full periphery foam gaskets.
- D. Side-Access Filter Mounting Frames:
 - 1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel Aluminum track.
 - a. Prefilters: Incorporate an integral 2-inch- thick track with same access as primary filter.
 - b. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.7 DAMPERS

- A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."
- B. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."

- C. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
- D. Combination Filter and Mixing Section:
 - 1. Cabinet support members shall hold 2-inch- thick, pleated, flat, permanent or throwaway filters.
 - 2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.
- E.

2.8 INTAKE AND RELIEF AIR OPENINGS

- A. Provide hood, including moisture eliminator, over all unit intake and relief openings. Match material and finish of casing exterior.

2.9 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000 -hour salt-spray test according to ASTM B117.
 - 1. Standards:
 - a. ASTM B117 for salt spray.
 - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
 - c. ASTM B3359 for cross-hatch adhesion of 5B.
 - 2. Application: Spray.
 - 3. Thickness: 1 mil.
 - 4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.10 SOURCE QUALITY CONTROL

- A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.
- B. AHRI 1060 Certification: Test, rate, and label air-handling units that include air-to-air energy recovery devices in accordance with AHRI 1060.
- C. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260 or AMCA 311.
- D. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210.
- E. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.
- F. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.
- G. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.
- H. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.
- I. Witnessed Casing Leakage Tests:
 - 1. Pay for all expenses, for one representative designated by Owner, to travel to the factory to witness cabinet air-leakage testing on the specific assembled unit(s) prior to release for delivery to Project site.
 - 2. If the unit(s) does not meet specified leakage requirements, perform factory modifications and retest. Do not release unit for shipment until tested leakage is measured to be within specified leakage and leakage testing report has been accepted by Owner's designated representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to air-handling unit, allow space for service and maintenance.
- C. Connect condensate drain pans using NPS 1-1/4 , ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- E. Steam and Condensate Piping: Comply with applicable requirements in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Install shutoff valve at steam supply connections, float and thermostatic trap, and union or flange at each coil return connection. Install gate valve and inlet strainer at supply connection of dry steam humidifiers, and inverted bucket steam trap to condensate return connection.
- F. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 - 6. Verify that zone dampers fully open and close for each zone.
 - 7. Verify that face-and-bypass dampers provide full face flow.
 - 8. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
 - 9. Comb coil fins for parallel orientation.
 - 10. Install new, clean filters.
 - 11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
 - 2. Measure and record motor electrical values for voltage and amperage.
 - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 1 visit to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

3.10 DEMONSTRATION

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

END OF SECTION 237343.16

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SECTION 238113.11 - PACKAGED TERMINAL AIR-CONDITIONERS, THROUGH-WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes packaged, terminal, through-the-wall air conditioners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
 - 2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.
 - 3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Amana; Whirlpool Corporation.
2. Carrier Global Corporation.
3. ClimateMaster, Inc.
4. Comfort-Aire; a division of Heat Controller, Inc.
5. Friedrich Air Conditioning Company.
6. LG Electronics USA, Inc.; LG Electronics Inc.

2.2 MANUFACTURED UNITS

- A. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with cord-connected hardwired chassis.
- 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. ASHRAE Thermal Comfort: Applicable requirements in ASHRAE 55.
- D. UL listed and ETL performance certified.

2.3 CHASSIS

- A. Cabinet: 0.052-inch- thick galvanized steel with removable front panel with concealed latches.
 1. Mounting: Floor with subbase.
 2. Top: Angled.
 3. Discharge Grille: Extruded-aluminum discharge grille, tamperproof, and carrying a flame test rating in accordance with UL standard 494.
 4. Louvers: Extruded aluminum with enamel finish; white color.
 5. Finish: Baked enamel.
 6. Access Door: Hinged door in top of cabinet for access to controls.
 7. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
 8. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 9. Electrical Subbase: Enameled steel with four adjustable leveling feet and adjustable end plates, with factory-installed and -wired, fused disconnect switch and receptacle sized for unit.
 10. Wall Sleeves: Galvanized steel with polyester finish.
- B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with vibration isolation and overload protection.
 1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.
 2. Charge: R-410A.
- C. Indoor Fan: Forward curved, centrifugal; with two-speed motor and positive-pressure ventilation damper with electric operator.

- D. Filters: Washable polyurethane in molded plastic frame.
- E. Condensate Drain: Drain pan to direct condensate to outdoor coil for re-evaporation.
 - 1. Comply with ASHRAE 62.1 for drain pan construction and connections.
- F. Outdoor Fan: Forward curved, centrifugal or propeller type with separate motor.
 - 1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Fan Motors: Permanently lubricated split capacitor.
 - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.4 HEATING

- A. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

2.5 CONTROLS

- A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:
 - 1. Low-Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.
 - 2. Temperature-Limit Control: Prevents occupant from exceeding preset setback or setup temperature.
 - 3. Building Automation System Interface: Allows remote on-off control with setback temperature control.
 - 4. Reverse-Cycle Defrost: Solid-state sensor monitors frost buildup on outdoor coil and reverses unit to melt frost.
- B. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage, adjustable thermostat with heat anticipator; heat-off-cool-auto switch; and on-auto fan switch.
- C. Outdoor Air: Motorized intake damper. Open intake when unit indoor-air fan runs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

- B. Install wall sleeves in finished wall assembly, seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

3.2 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. After operational test, change filters.
- C. Packaged, terminal air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged, terminal air conditioners.

END OF SECTION 238113.11

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: Five year(s) from date of Substantial Completion.
 - c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Global Corporation.
 - 2. Daikin.
 - 3. Mitsubishi Electric & Electronics USA, Inc.
 - 4. Trane.
 - 5. YORK; brand of Johnson Controls International plc, Building Solutions North America.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:
 - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 2. Insulation: Faced, glass-fiber duct liner.
 - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
 - 5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

- c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. Filters: Permanent, cleanable.
 8. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
 - 2) Depth: A minimum of 2 inches deep.
 - b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 3. Fan: Direct drive, centrifugal.
 4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - e. Mount unit-mounted disconnect switches on exterior of unit.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 6. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
 - 2) Depth: A minimum of 1 inch deep.
 - b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum MERV according to ASHRAE 52.2.

- 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: 1 inch .
 - 3) MERV according to ASHRAE 52.2: 8 .
 - 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 INDOOR UNITS (6 TONS OR MORE)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.
 - d. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: 1 inch thick, in fiberboard frames .
9. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
 - 2) Depth: A minimum of 2 inches deep.
 - b. Single-wall, stainless-steel sheet.
 - c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1 .
 - e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

- f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Refrigerant: ,R-32, R-410A, or R-454B .
 - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat, where heat pump operation is indicated on the Drawings.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 0 deg F. Provide the accessories needed to meet this requirement per manufacturer instructions.
7. Mounting Base: Polyethylene.

2.5 OUTDOOR UNITS (6 TONS OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant: R-410A .
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.6 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components 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. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- B. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

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SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. DDC: Direct digital control.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Berko; Marley Engineered Products.
2. Carrier Corporation.
3. INDEECO.
4. Markel Products; TPI Corporation.
5. QMark; Marley Engineered Products.
6. Trane.

2.2 DESCRIPTION

- A. Factory-assembled and -tested unit complying with AHRI 440.
- 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 UL 2021.

2.3 PERFORMANCE REQUIREMENTS

2.4 COIL SECTION INSULATION

- A. Insulation Materials: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
 1. Thickness: 1/2 inch.
 2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F mean temperature.
 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
 4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.5 CABINETS

- A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0677-inch- thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 2. Recessed Flanges: Steel, finished to match cabinet.
 3. Control Access Door: Key operated.
 4. Extended Piping Compartment: 8-inch- wide piping end pocket.
 5. Outdoor-Air Wall Box: Minimum 0.1265-inch- thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen; aluminum louver with baked-enamel finish in color selected by Architect from manufacturer's standard colors.
 - a. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with electronic, two-position actuators.

2.6 FILTERS

- A. Minimum Efficiency Reporting Value and Average Arrestance: According to ASHRAE 52.2.
- B. Minimum Efficiency Reporting Value: According to ASHRAE 52.2.
- C. Material: Pleated cotton-polyester media, MERV 7.

2.7 COILS

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

2.8 CONTROLS

- A. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, high static, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- B. Basic Unit Controls:
 - 1. Control voltage transformer.
 - 2. Wall -mounted temperature sensor.
 - 3. Unoccupied period override push button.
 - 4. Data entry and access port.
 - a. Input data includes room temperature and occupied and unoccupied periods.
 - b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.
- C. DDC Terminal Controller:
 - 1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
 - 2. Unoccupied Period Override: Two hours.
 - 3. Unit Supply-Air Fan Operations:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain setback room temperature.
 - 4. Heating-Coil Operations:

- a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
 - b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.
5. Controller shall have volatile-memory backup.
- D. Interface with DDC System for HVAC Requirements:
1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at central workstation.
 3. Interface shall be BAC-net compatible for central DDC system for HVAC workstation and include the following functions:
 - a. Adjust set points.
 - b. Cabinet unit-heater start, stop, and operating status.
 - c. Data inquiry, including supply-air and room-air temperature.
 - d. Occupied and unoccupied schedules.
- E. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly, seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 "Hydronic Piping Specialties," Section 232213 "Steam and Condensate Heating Piping," and Section 232216 "Steam and Condensate Heating Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
- G. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of cabinet unit heater. Steam specialties are specified in Section 232216 "Steam and Condensate Heating Piping Specialties."
- H. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 238239.13

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements applicable to Work specified in Division 26.

1.2 REFERENCES

A. Definitions:

1. Basic Impulse Insulation Level: Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
2. Direct Buried: Installed underground without encasement in concrete or other protective material.
3. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - j. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.

- k. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - l. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - m. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - n. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- 4. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
 - 5. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (healthcare facilities)
 - 6. Jacket: A continuous nonmetallic outer covering for conductors or cables.
 - 7. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
 - 8. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
 - 9. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
 - 10. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
 - 11. Sheath: A continuous metallic covering for conductors or cables.
 - 12. UL Category Control Number: An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
 - 13. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage: Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.

1.3 COORDINATION

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Include the following information:

- a. Manufacturer's operating specifications.
- b. User's guides for software and hardware.
- c. Schedule of maintenance material items recommended to be stored at Project site.
- d. Detailed instructions covering operation under both normal and abnormal conditions.
- e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
- f. List of load-current and overload-relay heaters with related motor nameplate data.
- g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
- h. Manufacturer's instructions for setting field-adjustable components.
- i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.

B. Software and Firmware Operational Documentation: Provide software and firmware operational documentation in Facility EPM Program Binders, including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.

1.5 QUALIFICATIONS

A. Electrical Power Monitoring Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.

B. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.

C. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials or unexpired LPI Master Installer credentials prior to starting installation.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
 2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
 3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.2 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

3.3 CLOSEOUT ACTIVITIES

- A. Training:
1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
 - a. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
 - b. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and

- understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
- c. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
 - d. How to adjust, operate, and maintain equipment specified in Section 262923 "Variable-Frequency Motor Controllers."
 - e. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
 - f. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."
 - g. How to adjust, operate, and maintain devices specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."
 - h. How to adjust, operate, and maintain luminaires specified in Section 265619 "LED Exterior Lighting."
2. Provide video recordings of training sessions to Owner.

END OF SECTION 260010

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Fire-alarm wire and cable.
4. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 INFORMATIONAL SUBMITTALS

- ##### A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- ##### A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- ##### B. 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. Cerro Wire LLC.
2. Encore Wire Corporation.
3. General Cable; Prysmian Group North America.
4. Okonite Company (The).
5. Southwire Company, LLC.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type XHHW-2: Comply with UL 44.
 - 2. Type THHN and Type THWN-2. Comply with UL 83.
- F. Shield:
 - 1. Type TC-ER: Cable designed for use with ASDs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: 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. AFC Cable Systems; Atkore International.
 - 2. Encore Wire Corporation.
 - 3. General Cable; Prysmian Group North America.
 - 4. Okonite Company (The).
 - 5. Southwire Company, LLC.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
 - 1. Type THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Aluminum, interlocked.

2.3 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Wire & Cable Inc.
 2. CommScope, Inc.
 3. Comtran Corporation.
 4. Genesis Cable Products; Honeywell International, Inc.
 5. nVent (PYROTENAX).
 6. Prysmian Cables and Systems; Prysmian Group North America.
 7. Radix Wire.
 8. Rockbestos-Suprenant Cable Corp.
 9. Superior Essex Inc.
 10. West Penn Wire.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No 18 AWG. .
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 18 AWG, minimum, in pathway.
 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs 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 use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M Electrical Products.
 2. AFC Cable Systems; Atkore International.
 3. Hubbell Utility Solutions; Hubbell Incorporated.
 4. Ideal Industries, Inc.
 5. ILSCO.
 6. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Install fire alarm cabling in raceways.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 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.
- C. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "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.
- C. Conductors shall be color-coded the entire length to indicate phases, neutral, and ground.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. 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 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ground bonding common with lightning protection system.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Submittals:

1. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B3.
 2. Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, copper lugs. Rated for 600 A.
- M. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- O. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum
 - b. Listed for direct burial.
 - 2. U-bolt type listed for indicated application.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch by 10 ft.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
- C. Grounding Conductors: Green-colored insulation.
- D. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
 - 2. Identify each grounding electrode that is connected to a common ground bus. The common ground bus shall not be less than 2" high by 1/4" thick.
- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- G. The raceway system shall not be relied on for equipment ground continuity. A green equipment grounding conductor shall be run in all raceways except for telecommunications, data, audio systems, and low voltage raceways for fire alarm systems.
- H. Boxes with concentric, eccentric, or over-sized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250-122 and lugged to the box.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.5 EQUIPMENT 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 inch below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. 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. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. 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.

F. 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. Bond each aboveground portion of ident system downstream from equipment shutoff valve.

G. 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 ft. apart.

H. 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.

1. Install tinned-copper conductor not less than No. 3/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inch from building's foundation.

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. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

J. Grounding electrode conductors #4 AWG and larger shall be installed in a raceway system.

K. All building interior portions of grounding electrode conductors less than 6 feet above finished floor shall be protected against physical damage by routing in raceway except for final terminations to equipment where concealed.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

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 calibrated torque wrench in accordance with manufacturer's published instructions.

3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by 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 in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- B. Nonconforming Work:
 1. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Collect, assemble, and submit test and inspection reports.

3.7 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at a maximum of 8 inch on center in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Allied Tube & Conduit; Atkore International.
 - c. B-line; Eaton, Electrical Sector.
 - d. Unistrut; Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 2. Toggle Bolts: All steel springhead type.
 - 3. Hanger Rods: Threaded steel.
- E. Powder actuated fasteners are not allowed.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101
 - 2. NECA NEIS 102.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- D. 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 single-bolt conduit clamps.
- E. 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 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT and ERMC may be supported by openings through structure members, in accordance with 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 must 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. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. 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 seismic-restraint strength and anchorage requirements.
- 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 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

a. 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 A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S and Type FMC-A duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

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. Allied Tube & Conduit; Atkore International.
 - b. Calconduit; Atkore International.
 - c. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - d. Western Tube; Zekelman Industries.
 - e. Wheatland Tube; Zekelman Industries.
2. Material: Steel.
 3. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc with organic top coating.
 - c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN DYIX; including UL 6.

B. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit; Atkore International.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
 - d. Wheatland Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
3. Options:
 - a. Interior Coating: Zinc with organic top coating.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE FMC-S AND TYPE FMC-A DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited

- by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN DXUZ; including UL 1.
- B. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):
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. ABB, Electrification Business.
 - b. Electri-Flex Company.
 - c. Topaz Lighting & Electric.
 2. Material: Steel.
 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- C. UL DXUZ - Aluminum Flexible Metal Conduit (FMC-A):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Anaconda Sealtite; Anamet Electrical, Inc.
 - c. Electri-Flex Company.
 - d. Topaz Lighting & Electric.
 2. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 TYPE LFMC DUCT RACEWAYS

- A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
 2. Listing Criteria: UL CCN DXHR; including UL 360.
- B. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
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. ABB, Electrification Business.

- b. Electri-Flex Company.
 - c. International Metal Hose Co.
2. Material: Steel.
 3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN DZYR; including UL 651.

B. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

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. ABB, Electrification Business.
 - b. Calconduit; Atkore International.
 - c. Topaz Lighting & Electric.
2. Dimensional Specifications: Schedule 40.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.

B. UL DWTT - Fittings for Type ERM, Type IMC, Type PVC, Type HDPE, Type EPEC, and Type RTRC Duct Raceways:

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. ABB, Electrification Business.
 - b. Appleton; Emerson Electric Co., Automation Solutions.
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - d. Konkore Fittings; Atkore International.
 2. Listing Criteria: UL CCN DWTT; including UL 514B.
 3. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
 - C. UL FKAV - Fittings for Type EMT Duct Raceways:
 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. ABB, Electrification Business.
 - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 2. Listing Criteria: UL CCN FKAV; including UL 514B.
 3. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling. Using set screw, crimp, or diecast compression fittings is not allowed.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
 - D. UL ILNR - Fittings for Type FMC Duct Raceways:
 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. American Fittings Corp. (AMFICO).
 - b. Liquid Tight Connector Co.
 - c. Southwire Company, LLC.
 2. Listing Criteria: UL CCN ILNR; including UL 514B.
 - E. UL DXAS - Fittings for Type LFMC Raceways:
 1. Listing Criteria: UL CCN DXAS; including UL 514B.
- 2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT
- A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.8 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed and Subject to Physical Damage: ERM C.
 2. Concealed Aboveground: EMT.
 3. Direct Buried: PVC-40.
 4. Concrete Encased in Trench: PVC-80 PVC-40.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
 1. Exposed and Subject to Physical Damage: ERM C. Locations include the following:
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 2. Exposed and Not Subject to Physical Damage: EMT.
 3. Concealed in Ceilings and Interior Walls and Partitions: FMC.
 4. Damp or Wet Locations: ERM C.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC FMC.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 - 2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
 - 3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
 - 4. Type FMC-A: Article 348 of NFPA 70 and NECA NEIS 102.
 - 5. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
 - 6. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
 - 7. Expansion Fittings: NEMA FB 2.40.
 - 8. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
 - c. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
 - d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - f. Support conduit within 12 inches of enclosures to which attached.
 - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
 - h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct 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 duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway 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.

- i. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - j. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - k. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
2. Types ERM and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Types FMC and LFMC:
 - a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC:
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent welding and fittings.
5. Duct Raceways Embedded in Slabs:
 - a. Run duct raceways larger than metric designator 27 (trade size 1) below concrete slab.
 - b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - c. Arrange duct raceways to ensure that each is surrounded by minimum of 2 inch of concrete without voids.
 - d. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
6. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT, IMC, or ERM for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
7. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

- a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - b. EMT: Provide compression , steel fittings. Comply with NEMA FB 2.10.
 - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
8. Expansion-Joint Fittings:
- a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
 - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 4) Attics: 135 deg F temperature change.
 - c. 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.
 - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
9. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.3 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 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.
4. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.

B. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables,

- with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 3. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: Minimum 2.5 inch.
 - c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
 - d. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.
- C. UL QCIT - Metallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
- D. UL QCIT - Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
 2. Options:
 - a. Material: Sheet steel Sheet aluminum.
 - b. Sheet Metal Depth: minimum 2.5 inch.
- E. UL QCIT - Metallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
- F. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pass & Seymour; Legrand North America, LLC.
 - b. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Wiremold; Legrand North America, LLC.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

G. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - b. Wiremold; Legrand North America, LLC.
 - c. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2.2 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.

B. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Additional Characteristics: UL Category Control Number CYIV.
3. Options:
 - a. Degree of Protection: Type 1.

C. Indoor Sheet Metal Cutout Boxes:

1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Cooper B-line; brand of Eaton, Electrical Sector.
 - c. Hoffman; brand of nVent Electrical plc.
 - d. Square D; Schneider Electrical USA.
3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
 - a. Degree of Protection: Type 1.

D. UL BGUIZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Options:
 - a. Degree of Protection: Type 1.

E. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
 - a. Degree of Protection: Type 3R.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. UL QUIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
 - b. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - e. Wiremold; Legrand North America, LLC.
2. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Wallplate Material: 0.032 inch thick, Type 302/304 non-magnetic stainless steel with brushed finish.

2.4 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. Listing Criteria:

- a. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
3. Mounts to box using fasteners different from wiring device.
- B. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:
 1. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
 2. Options:
 - a. Provides clear, weatherproof, "while-in-use" cover.
 - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations in-Ground or Exposed to Corrosive Agents: Type 4X .
 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 1. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Special Installation Techniques:
 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
 2. Junction and pull boxes above suspended ceiling shall be located between (3) and (36) inches above the suspended ceiling for accessibility. Removal of duct or ceiling grid shall not be required to access pull or junction boxes.

3. 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.
4. 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, whether installed indoors or outdoors.
5. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
6. Locate boxes so that cover or plate will not span different building finishes.
7. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
8. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
9. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
10. Set metal floor boxes level and flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solvent cements.
2. Duct accessories.
3. Handholes and boxes for exterior underground wiring.
4. Manholes for exterior underground wiring.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260533 "Raceways and Boxes for Electrical Systems".

1.2 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- C. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- D. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Duct-bank materials, including spacers and miscellaneous components.
2. Ducts, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes.
4. Underground-line warning tape.

PART 2 - PRODUCTS

2.1 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council).
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.2 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Cantex Inc.

B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

2.3 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. ASTM C858 for design and manufacturing processes.
 - b. SCTE 77.

B. Precast Concrete Handholes and Boxes :

1. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.
2. Manufacturers: Subject to compliance with requirements, undefined:
 - a. Christy Concrete Products.
 - b. Oldcastle Infrastructure Inc.; CRH Americas.
 - c. Utility Concrete Products, LLC.
3. Configuration: Units must be designed for flush burial and have integral closed bottom unless otherwise indicated.

4. Frame and Cover:
 - a. Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 - b. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - c. Cover Legend: Molded lettering, "ELECTRIC".
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension must provide increased depth of 12 inch .
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
7. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations.
 - a. Splayed location.
 - b. Knockout panels must be located no less than 6 inch from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - d. Knockout panels must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - e. Knockout panels must be 1-1/2 to 2 inch thick.
8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size: Match fittings to duct to be terminated.
 - b. Fittings must align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
 - c. Provide minimum of one cast end-bell or duct-terminating fitting of each size provided in each wall.
9. Handholes 12 inch wide by 24 inch long and larger must have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NewBasis.
 - b. Oldcastle Infrastructure Inc.; CRH Americas.
 - c. Quazite; Hubbell Incorporated, Power Systems.
3. Configuration: Units must be designed for flush burial and have integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.
 - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - b. Cover Legend: Molded lettering, "ELECTRIC" .
5. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.

6. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
7. Handholes 12 inch wide by 24 inch long and larger must have factory-installed inserts for cable racks and pulling-in irons.
8. Options:
 - a. Color: Gray .

D. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover:

1. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Christy Concrete Products.
 - b. NewBasis.
 - c. Oldcastle Infrastructure Inc.; CRH Americas.
 - d. Quazite; Hubbell Incorporated, Power Systems.
3. Configuration: Units must be designed for flush burial and have closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - b. Cover Legend: Molded lettering, "ELECTRIC" .
5. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
6. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
7. Handholes 12 inch wide by 24 inch long and larger must have factory-installed inserts for cable racks and pulling-in irons.
8. Options:
 - a. Color: Gray .

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct into handholes and boxes with final locations and profiles of duct, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

- A. Duct for Electrical Feeders 600 V and Less: PVC-40 , concrete encased unless otherwise indicated.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Handholes and Boxes:
 - 1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
 - 2. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
 - 3. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin , structurally tested in accordance with SCTE 77 with 3000 lbf vertical loading.
 - 4. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

- A. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
 - 2. Consult Architect for resolution of conflicting requirements.
- B. Special Techniques:
 - 1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

2. Steel raceway, bends, and fittings in single duct run or duct bank must be of same type.
3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
5. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch.
6. Curves and Bends:
 - a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch , both horizontally and vertically, at other locations unless otherwise indicated.
 - b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch . Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
 - c. Duct must have maximum of 180 degrees of bends between pull points.
7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
 - a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.
8. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing duct will not be subject to environmental temperatures above 104 deg F. Where environmental temperatures are calculated to rise above 104 deg F, and anywhere duct crosses above underground steam line, install insulation blankets listed for direct burial to isolate duct bank from steam line to maintain maximum environmental temperature of 104 deg F.
9. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.
10. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
11. Direct-Buried Duct and Duct Bank:
 - a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
 - b. Width: Excavate trench 3 inch wider than duct on each side.
 - c. Depth: Install top of duct at least 36 inch below finished grade unless otherwise indicated.
 - d. Set elevation of top of duct bank below frost line.
 - e. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
 - f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - g. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

- h. Install duct with minimum of 3 inch between ducts for like services and 6 inch between power and communications duct.
- i. Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
- j. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.
 - 1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete.
 - 2) Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch from edge of base. Install insulated grounding bushings on terminations at equipment.
 - a) Stub-ups must be minimum 4 inch above finished base and minimum 3 inch from conduit side to edge of base.
 - 3) Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally on exterior of wall minimum of 60 inch from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 4) Stub-ups through interior floors must be minimum 4 inch above finished floor and no less than 3 inch from conduit side to edge of equipment pad or floor slab.
- k. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
- 12. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
- 13. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

- 1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
- 2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

- 1. Elevations:
 - a. Install handholes with bottom below frost line, below grade.

- b. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- c. Where indicated, cast handhole cover frame integrally with handhole structure.
2. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
3. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
4. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
5. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
6. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch for manholes and 2 inch for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
7. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Reference Standards:

1. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line, below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

7. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth .
 - a. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with troweled finish.
 - b. Dimensions: 10 inch wide by 12 inch deep .
8. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
 1. Sweep floor, removing dirt and debris.
 2. Remove foreign material.

END OF SECTION 260543

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve seal systems.
3. Grout.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 SLEEVE SEAL SYSTEMS

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

1. CALPICO, Inc.
2. Metraflex Company (The).
3. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Fiber-reinforced plastic.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000 psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed or seismic criteria require different clearance.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

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SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Neoprene Isolation Washers and Grommets
3. Restraints - rigid type.
4. Restraints - cable type.
5. Restraint accessories.
6. Post-Installed concrete anchors.
7. Concrete inserts.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 DEFINITIONS

- ##### A. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Component Supports:

1. Load ratings, features, and applications of reinforcement components must be based on testing standards of a nationally recognized testing agency.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: NP.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Ribbed or waffled on both sides.
6. Minimum thickness 0.75 inches.
7. Load-bearing metal plates adhered to pads as recommended by isolation pad manufacturer for loading conditions.
8. Sandwich-Core Material: Resilient and elastomeric.

2.3 NEOPRENE ISOLATION WASHERS AND GROMMETS

A. Neoprene Isolation Washers and Grommets: IWG.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kinetics Noise Control, Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Eliminator Co., Inc.
 - d. Vibration Mountings & Controls, Inc.
 - e. Vibro-Acoustics.
2. Neoprene isolation washer and grommets shall have a nominal durometer of Shore 50A.

2.4 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CADDY; nVent.
 2. Gripple Inc.

3. International Seismic Application Technology (ISAT).
4. Kinetics Noise Control, Inc.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Mountings & Controls, Inc.
8. Vibro-Acoustics.

- B. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.5 CONCRETE INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. DeWALT.
 2. Gripple, Inc.
 3. Hilti, Inc.
 4. International Seismic Application Technology (ISAT).
 5. Simpson Strong-Tie Co., Inc.
- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.
- C. Comply with MSS SP-58.

PART 3 - EXECUTION

3.1 VIBRATION ISOLATION

- A. General:
1. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.
 2. Vibration isolators shall be installed and connected, as specified herein, or as indicated on the Drawings, in accordance with the manufacturer's written instruction and certified submittal data.
- B. Equipment Isolation:
1. Floor-mounted transformers shall be mounted on Type DN isolators with a minimum static deflection of 0.1".
 2. Suspended transformers shall be supported with Type NH isolators with a minimum static deflection of 0.1".

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Labels.
 - 2. Tapes and stencils.
 - 3. Tags.
 - 4. Signs.
 - 5. Cable ties.
 - 6. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME 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. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F , material surfaces .

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
1. Labels shall match the color scheme outlined in Section 2.2E.
 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.
 4. Color for Equipment Grounds: Green.
 5. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- F. Equipment Identification Labels:
1. Blue surface with white core for 120/208-volts equipment.
 2. Black surface with white core for 277/480-volts equipment.
 3. Purple surface with white core for all equipment related to TV systems.

2.3 LABELS

- A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.

2.4 TAPES AND STENCILS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- B. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. Seton Identification Products; a Brady Corporation company.
 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE/DATA", "TELEVISION", "SECURITY", and FIRE COMMUNICATIONS".
 3. Tape:
 - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 8 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft.
 - f. Tensile according to ASTM D882: 300 lbf and 12,500 psi.

2.5 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.6 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 14 by 10 inches.

B. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Self-adhesive.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. 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).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. 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.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
- J. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
- K. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- L. Underground Line Warning Tape:
 - 1. 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 or concrete envelope exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- M. Nonmetallic Preprinted Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using general-purpose cable ties.
- N. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.
- O. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.
- P. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl tape applied in bands.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels self-adhesive wraparound labels to identify the phase.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors.

- G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- H. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 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.
- K. Arc Flash Warning Labeling: Self-adhesive labels.
- L. Operating Instruction Signs: Baked-enamel warning signs.
- M. Equipment Identification Labels:
 - 1. Indoor Equipment: Baked-enamel signs.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Variable-speed controllers.

END OF SECTION 260553

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SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- C. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- D. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Submit the following concurrently or prior to the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.
 - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

- 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 CLOSEOUT SUBMITTALS

- A. A complete copy of the study, along with a tabulation of all individual breaker settings, shall be presented to the Owner no later than at completion of building Level 4 commissioning. This shall include a soft copy of the input data that was used to determine the fault current levels, to enable future re-evaluation of the system if loads are added or removed or parameters are changed.
- B. Operation and Maintenance Data:
 1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 2. The following are from the Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Short-Circuit Study Report.
 - c. Short-circuit study data files.
 - d. Power system data.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- 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. EasyPower, LLC (formerly ESA Inc.).
 2. Power Analytics, Corporation.
 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 6. Derating factors and environmental conditions.
 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.

5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Data include, but are not limited to, the following:
 - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 7. Motor horsepower and NEMA MG 1 code letter designation.
 - 8. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 - 9. Derating factors.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Begin short-circuit current analysis at the service, extending down to the lowest bus of the power distribution system depicted in the riser diagram within the project drawings.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

- F. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- C. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- D. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and equipment evaluation reports.

2. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 CLOSEOUT SUBMITTALS

- A. A complete copy of the study, along with a tabulation of all individual breaker settings, shall be presented to the Owner no later than at the completion of building Level 4 commissioning. This shall include a soft copy of the input data that was used to determine the fault current levels, to enable future re-evaluation of the system if loads are added or removed or parameters are changed.
- B. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
 1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.
 - f. Power system data.

1.6 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- 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. EasyPower, LLC (formerly ESA Inc.).
 2. Power Analytics, Corporation.
 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 6. Any revisions to electrical equipment required by the study.
 7. Study Input Data: As described in "Power System Data" Article.
 - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:

- 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
- b. Circuit Breakers:
- 1) Adjustable pickups and time delays (long time, short time, and ground).
 - 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
- c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - b. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - c. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - d. Cables and conductors damage curves.
 - e. Ground-fault protective devices.
 - f. Motor-starting characteristics and motor damage points.
 - g. Generator short-circuit decrement curve and generator damage point.
 - h. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Maintain selectivity for tripping currents caused by overloads.
 6. Provide adequate time margins between device characteristics such that selective operation is achieved.
 7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
 - 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Data include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Electrical power utility impedance at the service.
 - 3. Power sources and ties.
 - 4. Short-circuit current at each system bus (three phase and line to ground).
 - 5. Full-load current of all loads.
 - 6. Voltage level at each bus.
 - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 - 9. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 10. Motor horsepower and NEMA MG 1 code letter designation.
 - 11. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
 - 12. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.

- b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Begin analysis at the service, extending down to the lowest bus of the power distribution system depicted in the riser diagrams within the project drawings.
- E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- F. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- G. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.

- H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- I. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- J. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- L. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Include in the report identification of any protective device applied outside its capacity.

3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with protective device coordination studies.

3.5 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
 - 1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
 - 2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
 - 3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- C. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- D. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
 - 3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing,

obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 CLOSEOUT SUBMITTALS

- A. A complete copy of the study, along with a tabulation of all individual breaker settings, shall be presented to the Owner no later than at completion of building Level 4 commissioning. This shall include a soft copy of the input data that was used to determine the fault current levels, to enable future re-evaluation of the system if loads are added or removed or parameters are changed.
- B. Operation and Maintenance Data:
 - 1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
 - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- 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. EasyPower, LLC (formerly ESA Inc.).
 - 2. Power Analytics, Corporation.
 - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.

- e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
- 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
 - 9. Hazard risk category.
 - 10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
- 1. Location designation.
 - 2. Nominal voltage.
 - 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 - 4. Arc flash PPE category.
 - 5. Required minimum arc rating of PPE in Cal/cm squared.
 - 6. Available incident energy.
 - 7. Working distance.
 - 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.
- D. Labels shall be provided for electrical equipment, such as switchboards, switchgear, panelboards, and meter socket enclosures that is likely to require examination, adjustment, servicing, or maintenance while energized as listed within paragraph 3.4.B.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
 - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 - 2. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Data include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance or available short circuit current at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus (three phase and line to ground).
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 9. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 10. Motor horsepower and NEMA MG 1 code letter designation.
 11. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
1. Low-voltage switchboard.

2. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
 3. Panelboard and safety switch over 250 V.
 4. Applicable panelboard and safety switch under 250 V.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
1. Indicate arc-flash energy.
 2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

END OF SECTION 260573.19

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SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Indoor occupancy and vacancy sensors.
2. Switchbox-mounted occupancy sensors.
3. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726.11 "General – Use – Switches, Dimmer Switches, and Fan – Speed Controller Switches" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- ##### A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

- A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 3. WattStopper; Legrand North America, LLC.
- B. General Requirements for Sensors:
1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Separate power pack.
 4. Hardwired connection to switch.
 5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
 6. Operation:
 - a. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 7. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
 8. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.

- b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 10. Bypass Switch: Override the "on" function in case of sensor failure.
 11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Lithonia Lighting; Acuity Brands Lighting, Inc.
 3. WattStopper; Legrand North America, LLC.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V.
- C. Wall-Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."

4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

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. 24 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. 18 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 OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. 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. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- C. Prepare test and inspection reports.
- D. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Power panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Power panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 4. 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 SPD as installed in panelboard.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Architect's written permission.
 - 3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. 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.

- 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. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
- 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 Areas: NEMA 250, Type 4X, stainless steel .
 - 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 5.
 - 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.
- F. 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. 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.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Terminations shall allow use of 75 deg C rated conductors without derating.
 - 2. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

3. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 4. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 5. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 6. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
- H. Future Devices: Panelboards 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.
- I. 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 SURGE PROTECTION DEVICES

- A. Manufacturers: Same as panelboard manufacturer.
- B. Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.
- C. Refer to Specification Section 266710 "Surge Protective Devices" for additional requirements.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB, Electrification Products Division.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- 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 Lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- 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: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Eaton.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; Schneider Electric USA.
- 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. Ground-Fault Protection: Integrally mounted Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.

2.6 INSTRUMENTATION

- A. Instruments shall be mounted integral to the panelboard with the meter's display visible without removing the dead front cover.
 1. Electronic power monitors with digital LCD or LED display, minimum 1% accuracy, on the load side of the main breaker or main lugs. Monitors shall be microprocessor-based devices with nonvolatile memory, local display of information, and Modbus RTU capabilities. Metered values (true RMS) shall include multiphase A and volts, watts, VARS, volt-amperes, watt-hours and VAR-hours, watts demand, frequency, and power factor.
 2. Manufacturer: Eaton IQ35M series, GE EPM 6000, Siemens PAC4200, or Square D PM5563.

2.7 IDENTIFICATION

- 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 door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

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.

1. SPDs shall be integrated within panelboards and shall be direct bus bar mounted.
 - 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 78 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.
 - O. Mount spare fuse cabinet in accessible location.
- 3.3 IDENTIFICATION
- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
 - B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. 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."
- E. 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.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. 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. 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.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated. as specified in Section 260573.16 "Coordination Studies."

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726.11 - GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-use dimmer switches.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Dimmer switches.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Description: Snap switches intended for mounting in device boxes.

B. Performance Criteria:

1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third parties shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
2. General Characteristics:
 - a. Reference Standards: UL CCN WMUZ and UL 20.

C. Toggle Switch :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Configuration:
 - 1) Extra-heavy-duty, 120-277 V, 20 A, single pole double pole three-way four way.
 - 2) Extra-heavy-duty, 120-277 V, 30 A, single pole double pole three way.

2.2 GENERAL-USE DIMMER SWITCHES

- A. Description: Line-voltage dimmers intended for mounting in flush device boxes or on outlet box covers (wall box).
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application. Third parties shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
 2. General Characteristics:
 - a. Reference Standards: UL CCN EOYX and UL 1472.
- C. Type I Dimmer Switch:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC.
 - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 2. Additional Characteristics: UL 1472 Type I dimmer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 - 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

END OF SECTION 262726.11

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SECTION 262726.31 - GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single straight-blade receptacles for plugs and attachment plugs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726.33 "General-Grade Duplex Straight-Blade Receptacles" for duplex receptacles.
3. Section 262726.37 "Receptacles with Ground-Fault Protective Devices" for GFCI receptacles.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Single straight-blade receptacles.

PART 2 - PRODUCTS

2.1 SINGLE STRAIGHT-BLADE RECEPTACLES FOR PLUGS AND ATTACHMENT PLUGS

- ##### A. Description: General-grade, single straight-blade receptacles for use in wiring systems recognized by NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application. Third parties agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.

2. General Characteristics:

- a. Reference Standards: UL CCN RTRT and UL 498.

- b. Surge Protective Devices: UL 1449, Type 3.
- C. Single Straight-Blade Receptacle:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 - 2. Options:
 - a. Configuration:
 - 1) Extra-heavy-duty, NEMA 5-20R.
 - 2) Extra-heavy-duty, NEMA 6-20R.
- D. Tamper-Resistant, Clock Hanger Straight-Blade Receptacle:
- 1. Manufacturers: Subject to compliance with requirements, undefined:
 - a. Pass & Seymour; Legrand North America, LLC.
 - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 - 2. Options:
 - a. Configuration: Recessed, smooth wallplate; NEMA 5-20R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - 4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.31

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SECTION 262726.33 - GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duplex straight-blade receptacles.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726.31 "General-Grade Single Straight-Blade Receptacles" for single receptacles.
3. Section 262726.37 "Receptacles with Ground-Fault Protective Devices" for GFCI receptacles.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Duplex straight-blade receptacles.

PART 2 - PRODUCTS

2.1 DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Description: General-grade duplex receptacles for use in wiring systems recognized by NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.

2. General Characteristics:

- a. Reference Standards:

- 1) UL CCN RTRT and UL 498.
- 2) Surge Protective Devices: UL 1449, Type 3.

C. Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Configuration:
 - 1) Extra-heavy-duty, NEMA 5-20R.
 - 2) Extra-heavy-duty, NEMA 6-20R.

D. Tamper-Resistant Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Configuration:
 - 1) Extra-heavy-duty, NEMA 5-20R.

E. Weather-Resistant Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Configuration:
 - 1) Extra-heavy-duty, NEMA 5-20R.

F. Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
 - a. Configuration:
 - 1) Heavy-duty, smooth face, NEMA 5-20R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 4. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.33

SECTION 262726.37 - RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles with GFCI devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726.31 "General-Grade Single Straight-Blade Receptacles" for single receptacles.
3. Section 262726.33 "General-Grade Duplex Straight-Blade Receptacles" for duplex receptacles that are not hospital grade.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Receptacles with GFCI devices.

PART 2 - PRODUCTS

2.1 RECEPTACLES WITH GFCI DEVICES

A. Description: Receptacles containing GFCI device for use in accordance with NFPA 70.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.

2. General Characteristics:

- a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

- C. General-Grade Duplex Straight-Blade Receptacle with GFCI Device :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 2. Options:
 - a. Configuration: Heavy-duty, NEMA 5-20R.
- D. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 2. Options:
 - a. Configuration: Heavy-duty, NEMA 5-20R.
- E. General-Grade, Weather-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leviton Manufacturing Co., Inc.
 - b. Pass & Seymour; Legrand North America, LLC.
 - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
 2. Options:
 - a. Configuration: Heavy-duty, NEMA 5-20R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions.

B. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.37

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bussmann; Eaton, Electrical Sector.
 - 2. Littelfuse, Inc.
 - 3. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
 - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 - 4. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class L, time delay Class RK1, time delay Class J, fast acting.
 - 2. Motor Branch Circuits: Class RK1, time delay.
 - 3. Large Motor Branch (601-4000 A): Class L, time delay.
 - 4. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Products Division.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
1. Single throw.
 2. Three pole.
 3. 600-V ac.
 4. 1200 A and smaller.
 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

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

1. ABB, Electrification Products Division.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- C. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.
4. Service-Rated Switches: Labeled for use as service equipment.

2.4 MOLDED-CASE CIRCUIT BREAKERS

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

1. ABB, Electrification Products Division.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) .
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock

mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.

- E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar

connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:

- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

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SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFC: Variable-frequency motor controller.
- L. VFD: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

- f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ABB.
 2. Danfoss Inc.
 3. Eaton.
 4. Schneider Electric USA, Inc.
 5. Siemens Industry, Inc., Building Technologies Division.
 6. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. Application: variable torque.
- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 10 kA.
 7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 8. Humidity Rating: Less than 95 percent (noncondensing).
 9. Altitude Rating: Not exceeding 3300 feet.
 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 11. Overload Capability: [1.1] [1.5] times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 13. Speed Regulation: Plus or minus [5] [10] percent.
 14. Output Carrier Frequency: Selectable; 0.5 to [15]<insert number> kHz.
 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.

- I. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 0.1 to 999.9 seconds.
 - 4. Deceleration: 0.1 to 999.9 seconds.
 - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.

- J. Self-Protection and Reliability Features:
 - 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - 3. Under- and overvoltage trips.
 - 4. Inverter overcurrent trips.
 - 5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 - 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 - 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - 8. Loss-of-phase protection.
 - 9. Reverse-phase protection.
 - 10. Short-circuit protection.
 - 11. Motor-overtemperature fault.

- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

- L. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
 - 1. Disconnect Rating: Not less than 115 percent of VFC input current rating.

2.3 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).

5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
1. Hardwired Points:
 - a. Monitoring: On-off status.
 - b. Control: On-off operation.
 2. Communication Interface: Comply with ASHRAE 135 (BACnet). Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.4 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Filtering: Provide dV/dT filters for drives where conductor length between drive and motor exceeds 100 foot.
- C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3.

2.5 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it and generates fault indications when overload protection activates.
 1. Configure to allow two or more motors to operate simultaneously at the same speed, separate overload relay for each controlled motor.
 2. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.

2.6 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

- A. Bypass contactor auxiliary contact(s).
- B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- D. Supplemental Digital Meters:
 - 1. Elapsed-time meter.
 - 2. Kilowatt meter.
 - 3. Kilowatt-hour meter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch VFC.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect selector switches and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).

5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges.

F. Set field-adjustable pressure switches.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

SECTION 263213.16 - GAS-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Engine.
2. Gas fuel system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor generator-set enclosure.
7. Vibration isolation devices.

- B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

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

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in cubic feet per hour (cubic meters per hour) at 0.8 power factor at 0.5, 0.75- and 1.0-times generator capacity.

5. Include generator efficiency at 0.8 power factor at 0.5, 0.75-, and 1.0-times generator capacity.
6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95 deg F, 80 deg F, 70 deg F, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Caterpillar, Inc.; Electric Power Division.
 2. Generac.
 3. Kohler Power Systems.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
 - 3. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- E. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 to 104 deg F.
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.
- C. Power Rating: Standby.
- D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.
- E. EPSS Class: Engine generator shall be classified as Class 48 according to NFPA 110.
- F. Governor: Adjustable isochronous, with speed sensing.
- G. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- H. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

I. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time:
 - a. Comply with NFPA 110, Type 10 system requirements.

2.4 GAS ENGINE

- A. Fuel: Natural gas.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499 and with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
- F. Muffler/Silencer:
1. Critical type sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 - a. Minimum sound attenuation of 25 dB at 500 Hz.
 - b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.
- G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
 2. Cranking Cycle: As required by NFPA 110 for system level specified.
 3. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
 4. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 5. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.

6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GAS FUEL SYSTEM

- A. Natural Gas Piping: Comply with requirements in Section 231123 "Facility Natural Gas Piping."
- B. Gas Train: Comply with NFPA 37.
- C. Engine Fuel System:
- D. Natural Gas, Vapor-Withdrawal System:
 1. Carburetor.
 2. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
 3. Fuel Filters: One for each fuel type.
 4. Manual Fuel Shutoff Valves: One for each fuel type.
 5. Flexible Fuel Connectors: Minimum one for each fuel connection.

2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates generator-set shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

- B. Comply with UL 508A.
- C. Configuration:
 - 1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.
- D. Control and Monitoring Panel:
 - 1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
 - a. Engine lubricating-oil pressure gage.
 - b. Engine-coolant temperature gage.
 - c. DC voltmeter (alternator battery charging).
 - d. Running-time meter.
 - e. AC voltmeter, for each phase.
 - f. AC ammeter, for each phase.
 - g. AC frequency meter.
 - h. Generator-voltage adjusting rheostat.
 - 3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:
 - a. Cranking control equipment.
 - b. Run-Off-Auto switch.
 - c. Control switch not in automatic position alarm.
 - d. Overcrank alarm.
 - e. Overcrank shutdown device.
 - f. Low water temperature alarm.
 - g. High engine temperature prealarm.
 - h. High engine temperature.
 - i. High engine temperature shutdown device.
 - j. Overspeed alarm.
 - k. Overspeed shutdown device.
 - l. Coolant low-level alarm.
 - m. Coolant low-level shutdown device.
 - n. EPS supplying load indicator.
 - o. Battery high-voltage alarm.
 - p. Low cranking voltage alarm.
 - q. Battery-charger malfunction alarm.
 - r. Battery low-voltage alarm.
 - s. Contacts for local and remote common alarm.
 - t. Remote manual stop shutdown device.
 - u. Air shutdown damper alarm when used.
 - v. Air shutdown damper shutdown device when used.
 - w. Hours of operation.

- x. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.
- E. Engine Generator Metering: Comply with Section 260913 "Electrical Power Monitoring and Control."
- F. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
 - 1. Overcrank alarm.
 - 2. Coolant low-temperature alarm.
 - 3. High engine temperature prealarm.
 - 4. High engine temperature alarm.
 - 5. Low lube oil pressure alarm.
 - 6. Overspeed alarm.
 - 7. Low fuel main tank alarm.
 - 8. Low coolant level alarm.
 - 9. Low cranking voltage alarm.
 - 10. Contacts for local and remote common alarm.
 - 11. Audible-alarm silencing switch.
 - 12. Air shutdown damper when used.
 - 13. Run-Off-Auto switch.
 - 14. Control switch not in automatic position alarm.
 - 15. Low cranking voltage alarm.
 - 16. Generator overcurrent protective device not closed.
 - 17. One set of unassigned auxiliary contacts that may be used to provide annunciation that the permanent emergency source is disconnected from the emergency system and is connected to a portable or temporary source of power.
- G. Remote Emergency-Stop Switch: Wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
 - 1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
 - 2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

- B. Generator Overcurrent Protective Device:
1. Molded-case circuit breaker, thermal-magnetic type; 100 percent rated; complying with UL 489:
 - a. Tripping Characteristic: Designed specifically for generator protection.
 - b. Trip Rating: Matched to generator output rating.
 - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
 - d. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- E. Enclosure: Dripproof.
- F. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
 2. Maintain voltage within 15 percent on one step, full load.
 3. Provide anti-hunt provision to stabilize voltage.
 4. Maintain frequency within 5 percent and stabilize at rated frequency within 2 seconds.

- G. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- H. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description:
 - 1. Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
 - 2. Prefabricated or pre-engineered galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure, erected on concrete foundation.
- B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.
- C. Hinged Doors: With padlocking provisions.
- D. Space Heater: Thermostatically controlled and sized to prevent condensation.
- E. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.
- F. Muffler Location: Within enclosure.
- G. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- H. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Minimum Deflection: 1 inch.
- B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
 - C. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
 - D. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 1. Tests: Comply with IEEE 115 and with NFPA 110, Level 1 Energy Converters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
 3. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure enclosure to anchor bolts installed in concrete bases.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Exhaust System: Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Piping sized in accordance with allowable back pressure for the engine and indicated on the mechanical plans.
1. Install flexible connectors and steel piping materials according to requirements in Section 232116 "Hydronic Piping Specialties."
 2. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."
- F. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe, the full size of the drain connection, with welded joints.
- G. Gaseous Fuel Piping:
1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 231123 "Facility Natural Gas Piping."
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Gaseous Fuel Connections:
1. Connect fuel piping to engines with a gate valve and union and flexible connector.
 2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.

3. Vent gas pressure regulators outside building a minimum of 60 inches from building openings.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.4 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency:

1. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs below as specified in the NETA ATS. Certify compliance with test parameters.

a. Visual and Mechanical Inspection:

- 1) Compare equipment nameplate data with drawings and specifications.
- 2) Inspect physical and mechanical condition.
- 3) Inspect anchorage, alignment, and grounding.
- 4) Verify the unit is clean.

b. Electrical and Mechanical Tests:

- 1) Test protective relay devices.
- 2) Verify phase rotation, phasing, and synchronized operation as required by the application.
- 3) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
- 4) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 6. Exhaust Emissions Test: Comply with applicable government test criteria.
 7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.16

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SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Contactor-type automatic transfer switches.
 - 2. Nonautomatic transfer switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.
- E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 2. Short-time withstand capability for three cycles.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically

and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

- J. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front access.
- M. Enclosures: General-purpose NEMA 250, Type 3R, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASCO Power Technologies.
 - 2. Eaton.
 - 3. Russelectric, Inc.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 - 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 5. Material: Hard-drawn copper, 98 percent conductivity.
 - 6. Main and Neutral Lugs: Mechanical type.
 - 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 8. Ground bar.
 - 9. Connectors shall be marked for conductor size and type according to UL 1008.

10. Switch shall have switched neutral and have fully rated neutral transfer contacts which shall momentarily interconnect the neutrals of the sources and load during the transfer/retransfer operation.
- D. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- E. Automatic Transfer-Switch Controller Features:
 1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

- a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
- b. Push-button programming control with digital display of settings.
- c. Integral battery operation of time switch when normal control power is unavailable.

2.3 NONAUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASCO Power Technologies.
 2. Eaton.
 3. Russelectric, Inc.
- B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- C. Manual and Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- D. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- E. Pilot Lights: Indicate source to which load is connected.
- F. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.
 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."
- G. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Switch Action: Double Throw, mechanically held in both directions.
 2. Contacts: Silver composition or silver alloy for load current switching.
 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 4. Material: Hard-drawn copper, 98 percent conductivity.
 5. Main and Neutral Lugs: Compression type.
 6. Ground bar.
 7. Connectors shall be marked for conductor size and type according to UL 1008.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Install transfer switches 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. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 - 3. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing equipment, test for compliance with requirements according to NETA ATS.

2. Visual and Mechanical Inspection:

- a. Compare equipment nameplate data with Drawings and Specifications.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and required clearances.
- d. Verify that the unit is clean.
- e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
- f. Verify that manual transfer warnings are attached and visible.
- g. Verify tightness of all control connections.
- h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
- i. Perform manual transfer operation.
- j. Verify positive mechanical interlocking between normal and alternate sources.
- k. Perform visual and mechanical inspection of surge arresters.
- l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

- a. Perform insulation-resistance tests on all control wiring with respect to ground.
- b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
- c. Verify settings and operation of control devices.
- d. Calibrate and set all relays and timers.
- e. Verify phase rotation, phasing, and synchronized operation.
- f. Perform automatic transfer tests.
- g. Verify correct operation and timing of the following functions:

- 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
 - D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 - E. Transfer switches will be considered defective if they do not pass tests and inspections.
 - F. Remove and replace malfunctioning units and retest as specified above.
 - G. Prepare test and inspection reports.

- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.
- D. Provide demonstration and training as specified in Section 260010 "Supplemental Requirements for Electrical".

END OF SECTION 263600

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SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes lightning protection system for ordinary structures.
- B. Section includes lightning protection system for the following:
 - 1. Ordinary structures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
 - 2. Include raceway locations needed for the installation of conductors.
 - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
 - 4. Include roof attachment details, coordinated with roof installation.
 - 5. Calculations required by NFPA 780 for bonding of metal bodies.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Completion Certificate:
 - 1. UL Master Label Certificate.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: UL-listed installer, category OWAY.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Lightning Technology Ltd.
 2. East Coast Lightning Equipment Inc.
 3. Harger Lightning & Grounding.
 4. Independent Protection Co.
 5. National Lightning Protection.
 6. Robbins Lightning, Inc.
 7. Thompson Lightning Protection, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96 and marked for intended location and application.

2.3 MATERIALS

- A. Electrical wire and cable shall have lead content less than 300 parts per million.
- B. Air Terminals:
1. Copper unless otherwise indicated.
 2. 5/8-inch diameter by 18 inches long.
 3. Rounded tip.
 4. Threaded base support.
- C. Class I Main Conductors:
1. Stranded Copper: 57,400 circular mils in diameter.
- D. Class II Main Conductors:
1. Stranded Copper: 115,000 circular mils in diameter.
- E. Secondary Conductors:
1. Stranded Copper: 26,240 circular mils in diameter.
- F. Ground Loop Conductor: Stranded copper.

- G. Ground Rods:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Rods shall be not less than 120 inches long.

- H. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96AandNFPA 780.

- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed installations in UL 96Aandconcealed systems in NFPA 780.
 - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
 - 2. Install conduit where necessary to comply with conductor concealment requirements.
 - 3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions. Adhesive shall be compatible with the roof material and shall not compromise the warranty of the roof.

- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

- B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: bolted connectors.

- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Bonded to the building electrode system.

3.3 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 1. Perform inspections as required to obtain a UL Master Label for system.
 2. Perform inspections to obtain an LPI certification.
- B. Prepare test and inspection reports and certificates.
 1. Upon completion and review by an NCBCB approved third-party lightning protection agency, Contractor shall obtain, and deliver to Owner the certifications.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General provisions and other electrical systems are specified in other Sections of Division 26.
- B. This Section covers surge protective devices (SPDs) for low-voltage, 600 V or less, electrical distribution equipment.

1.2 QUALITY ASSURANCE

- A. Conform to the following:
 - 1. IEEE C62.41.1
 - 2. IEEE C62.41.2
 - 3. North Carolina State Electrical Code - 2020.
 - 4. UL 1283
 - 5. UL 1449 4th edition
 - 6. UL 96A requirements related to SPDs and in coordination with the lightning protection system.
- B. SPDs shall have a 5 year warranty.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICES

- A. General:
 - 1. UL 1449 voltage protection rating (VPR) label shall be permanently affixed to the units.
 - 2. Maximum continuous operating voltage (MCOV) shall be greater than 115% of the nominal system operating voltage.
 - 3. Protection modes: for a wye-configured system, devices shall have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, devices shall have suppression elements between line-line (L-L) and line-ground (L-G).
 - 4. Nominal discharge current (in): SPDs applied to the distribution system shall have a 20 kA in rating regardless of their SPD type (including Types 1 and 2) or operating voltage.
 - 5. UL 1449 component voltage protection rating shall not exceed the following:
 - a. System Voltage 208Y/120:
 - 1) L-N; L-G; N-G: 700V.

- 2) L-L: 1200V.
- b. System Voltage 480Y/277:
 - 1) L-N; L-G; N-G: 1200V.
 - 2) L-L: 2000V.
6. Electrical noise filter: each unit shall include a high-performance EMI/RFI noise rejection filter.
7. Internal connections: internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
8. Overcurrent protection: each unit shall be provided with overcurrent protection to provide both thermal overload protection for small magnitude fault current conditions or temporary over voltage conditions as well as short circuit current protection for high magnitude fault conditions. Each MOV module or element shall be individually fused with 200000 RMS symmetrical AIC internal fuses.
9. Monitoring and Diagnostics:
 - a. SPDs shall be equipped with visible indication of proper connection and operation. Indicator lights shall indicate which phase as well as which module is fully operable.
 - b. SPDs shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of each enclosure.
 - c. SPDs shall be equipped with contacts for remote annunciation of alarm or trouble.
 - d. SPDs installed at service entrance locations or within switchboards shall be equipped with a transient event counter.
10. Each unit shall incorporate an integral test feature to verify the operational integrity of the unit's monitoring system.

2.2 SYSTEM APPLICATIONS

- A. SPD applications covered under this Section include distribution and branch circuit panelboard locations, and bus plugs.
- B. SPDs shall be designed and tested for application within IEEE C62.41.1-2002 (R2008) Category C, B, and A environments.
- C. Surge current capacity: the minimum surge current capacity that each unit is capable of withstanding shall be as follows:
 1. Distribution and Power Panelboards:
 - a. IEEE 62.41-2002 (R2008) Location Category B.
 - b. Minimum Surge Current Per Phase: 150 kA.
 - c. Minimum Surge Current Per Mode: 50 kA.
 - 1) L-G, L-N, and N-G (wye system); L-L, L-G (delta system).

2. SPD type: SPDs installed on the line side of the service entrance disconnect shall be Type 1. SPDs installed on the load side of the service entrance disconnect shall be Type 2.
3. Units shall be designed for IEEE C62.41.1-2002 (R2008) and IEEE C62.41.2-2002 (COR 1-2012) Category B environments.

2.3 MANUFACTURER

- A. Same as panelboard manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.
- B. Provide SPDs for distribution panelboards, branch-circuit panelboards, and busway where indicated in the Drawings. SPDs shall be installed integral to electrical distribution equipment by the electrical distribution equipment manufacturer.
 1. Locate SPDs on the load side of the main disconnect device, as close as possible to the phase conductors and ground and neutral bar.
 2. SPDs shall be integrated within panelboards and shall be direct bus bar mounted.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
 2. Inspect anchorage, alignment, grounding, and clearances.
 3. Verify that electrical wiring installation complies with manufacturer's installation requirements.
- B. Nonconforming Work:
 1. SPDs that do not pass tests and inspections will be considered defective.
 2. Remove and replace defective units and retest.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Materials.
- 2. Luminaire support.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

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

- 1. Arrange in order of luminaire designation.
- 2. Include data on features, accessories, and finishes.
- 3. Include physical description and dimensions of luminaires.
- 4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
 - 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.

1.5 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 WARRANTY

- A. Provide a minimum 5 year luminaire warranty.

2.2 PERFORMANCE REQUIREMENTS

- A. Altitude: Sea level to 1000 feet .

2.3 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
- B. Recessed luminaires shall comply with NEMA LE 4.

2.4 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 MAINTENANCE

- A. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire.
- B. Where LED luminaire is connected to a circuit greater than 50-volts an integral disconnect plug shall be provided for disconnecting the driver from the circuit.

2.6 ELECTRICAL AND PHOTOMETRIC REQUIREMENTS

- A. Operating voltage: 24 Vdc, 120 Vac at 60 Hz, 277 Vac at 60Hz, or universal voltage (120, 220/240, 277 Vac at 50/60 Hz).
- B. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range).
- C. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range).
- D. LED drivers shall operate from an input source of 47 Hz to 63 Hz and 90 V to 305 V.
- E. Sound: Class A not to exceed a measured value of 24dB.
- F. Maximum standby power: 1W.
- G. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
- H. LED Driver Robustness:
 1. Driver efficiency (at full load):
 - a. $\geq 85\%$ for drivers capable of ≥ 50 watts.
 - b. $\geq 80\%$ for drivers capable of < 50 watts.

2. Federal Communications Commission (FCC) compliance: FCC 47 Part 15 Non-Consumer limits for EMI/RFI emissions.

I. Temperature Rating:

1. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
2. The operating temperature range shall be 0°C to 25°C.

J. Thermal Management:

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LEDs manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient temperature.
3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature.
4. The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.

K. Flicker Criteria:

1. Adhere to IESNA standards for flicker and IEEE PAR1789 Recommended Practice to limit flicker to acceptable levels. Flicker needs to be considered at both the luminaire level when fully powered and when dimmed.

L. EMI/RFI:

1. The luminaire and associated on-board circuitry shall meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI Emissions.

M. Inrush Current:

1. Adhere to NEMA 410 requirements.

2.7 COLORMETRIC PERFORMANCE

- A. Correlated Color Temperature (CCT): Only allowed CCTs are 2700K, 3000K, 3500K, 4000/4100K, 4500K and 5000K.
- B. Acceptable tolerances as provided in ANSI C78.377-2015 (LED).
- C. Color Rendering Index (CRI) [Ra] ≥ 80 with a positive R9 value.
- D. Color shift of no less than $\Delta u'v' < 0.007$ during the warranty period.

2.8 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.9 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage .
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. 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 a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

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.

E. Wall-Mounted Luminaires:

1. Attached to structural members in walls.

F. Suspended Luminaires:

1. Ceiling Mount:
 - a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting.
2. Exit signs.
3. Materials.
4. Luminaire support components.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.
- B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - a. Include data on features, accessories, and finishes.
 - b. Include physical description of unit and dimensions.
 - c. Battery and charger for light units.
 - d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

- e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with NFPA 101.
- C. Comply with NEMA LE 4 for recessed luminaires.
- D. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
 - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1400 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 4. Battery: Sealed, maintenance-free, type.
 - 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EXIT SIGNS

- A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components must be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Conduit: FMC, minimum metric designator 21 (trade size 3/4).

2.4 METAL FINISHES

- ### A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

- ### A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- ### B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 0.106 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- ### A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- ### B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- ### C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- ### D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- ### A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

C. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

D. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48-inch, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Recessed Luminaire Support:

1. Recessed luminaires shall be supported from the structure independent of the ceiling support system. Provide at least two supports on diagonals where any horizontal dimension of the luminaire is 18" or larger. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track and shall be distinguished by color and tag. Attach one end of the wire to one corner of the luminaire and the other end to the building's structural system. The lay-in luminaire shall then be secured to the main runners of the lay-in ceiling track at minimum two diagonally opposite corners.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

3.5 SYSTEM STARTUP

A. Perform startup service:

1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 PROTECTION

- A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

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SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Materials.
- 2. Finishes.
- 3. Luminaire support components.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaire.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-79 .
6. Wiring diagrams for power, control, and signal wiring.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- C. Five years at minimum from date of Final Acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.8 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Third party agencies shall be amongst those accredited by the NCBC (North Carolina Building Code Council) to label electrical and mechanical equipment.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. L70 lamp life of 50,000 hours.
- H. Internal driver.
- I. Lamp Rating: Lamp marked for outdoor use.
- J. Surge suppression: Provide for outdoor pole mounted and ground mounted LED luminaires; surge suppressor shall be minimum 10.0- KV rated and integral to the driver.
- K. Source Limitations:
 - 1. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Stainless steel. Form and support to prevent warping and sagging.
- C. 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.
- D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Glass: Annealed crystal glass unless otherwise indicated.
 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.3 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. 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.
- C. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color:

- 1) As selected from manufacturer's standard catalog of colors.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming.

K. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 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 260533 "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.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265619

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Selection and installation of communications busbars.
2. Selection and installation of communications bonding conductors.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. BBC: Backbone bonding conductor, for connecting multiple TBBs serving the same floor.
- B. PBB (TMGB): Primary bonding busbar, located in main distribution frame room, ideally near electrical service entrance.
- C. RBB: Rack bonding busbar, located in equipment cabinets and racks.
- D. SBB (TGB): Secondary bonding busbar, located in intermediate distribution frame rooms.
- E. TBB: Telecommunications bonding backbone, for connecting SBBs to PBB.
- F. TBC: Telecommunications bonding conductor, for connecting PBB to intersystem bonding termination device or busbar at electrical service entrance.
- G. TEBC: Telecommunications equipment bonding conductor, for connecting RBBs to SBBs or PBB.
- H. UBC: Unit bonding conductor, for connecting individual communications equipment to RBBs or SBBs.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:

1. Installing wire connector on conductor.
2. Recommended torque values.

1.5 CLOSEOUT SUBMITTALS

A. Record Documentation: Project record documents in accordance with Section 017839 "Project Record Documents" must include locations of PBB and SBBs, and routing of TBC, TBBs, and BBCs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF COMMUNICATIONS BUSBARS

- A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. PBB:
 1. Dimensions: 1/4" Thick by 20" Wide .
 2. Stand-Off Distance: 4 inch .
 3. Insulated standoffs.
 4. Hole Pattern: 2-Hole lugs per ANSI/BICSI N3-20 and ANSI/TIA-607.

C. SBB:

1. Dimensions: 1/4" Thick by 12" Wide .
2. Stand-Off Distance: 2 inch .
3. Insulated standoffs.
4. Hole pattern: 2-Hole lugs per ANSI/BICSI N3-20 and ANSI/TIA-607.

D. RBB:

1. Horizontally oriented.
2. Rack-Mounted.
3.
 - a. Pairs of #1/4-20 tapped mounting holes on 5/8" centers with #5/16 self-clinching studs on 1" centers at one end for attachment of bonding conductor.
4.
 - a. Eight #6-32 tapped lug mounting holes on 1" centers and two pairs of 5/16" diameter holes spaced 3/4" apart for attaching jumpers.
- 5.

3.3 SELECTION OF COMMUNICATIONS BONDING CONDUCTORS

A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Communications Busbar Connections:

1. TBC: Not smaller than 1/0 AWG and no smaller than largest TBB.
2. TBB: Not smaller than 2 kcmil per linear ft of conductor length, but not larger than 750 kcmil, unless otherwise indicated on Drawings.
3. BBC: Not smaller than largest TBB to which it is connected unless otherwise indicated on Drawings.
4. TEBC: Not smaller than 2 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
5. UBC: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
6. Bonding Conductors to Structural Steel: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted clamp connectors.

C. Cable Tray Connections:

1. Cable Tray Equipment Grounding Conductor: 6 AWG .
2. Cable Tray Bonding Jumper: If not supplied by cable manufacturer, provide bonding jumper not smaller than 6 AWG and not longer than 12 inch. If jumper is wire, it must be terminated with lug having two holes and long barrel for two crimps. If jumper is flexible braid, it must be terminated with one- or two-hole ferrule . Attach with bonding screw or connector provided by cable tray manufacturer.

D. Underground Connections: Not smaller than 2 AWG . Provide welded connectors, except bolted connectors may be used in handholes or manholes and as otherwise indicated on Drawings.

3.4 INSTALLATION OF BONDING FOR COMMUNICATIONS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Bonding of Communications: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with BICSI N3.
 - 2. Consult Architect for resolution of conflicting requirements.
 - 3. NFPA 70
 - 4. NECA NEIS 1
 - 5. ANSI/BICSI N3-20
 - 6. ANSI/TIA-607
 - 7. Comply with requirements of AHJ.
- C. Special Techniques:
 - 1. Busbars:
 - a. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 12 inch above finished floor unless otherwise indicated.
 - b. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
 - 2. Conductors:
 - a. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
 - b. Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows:
 - 1) Use crimping tool and die specific to connector.
 - 2) Pretwist conductor.
 - 3) Apply antioxidant compound to bolted and compression connections.
 - c. Install in straightest and shortest route between origination and termination point, and no longer than required. Bend radius must not be smaller than 10 times diameter of conductor. No single bend may exceed 90 degrees.
 - d. Install without splices.
 - e. Support conductors at not more than 36 inch intervals.
 - f. Outside telecommunications rooms, install conductors in metric designator 21 (trade size 3/4) PVC-80 conduit until conduit enters telecommunications room. Install bonding conductors in EMT-A or EMT-SS when routed through plenum. Do not install bonding conductors in EMT-S unless otherwise indicated on Drawings.
 - 1) If bonding conductor must be installed in EMT-S or other ferrous metallic raceway, bond conductor to raceway using grounding bushing that complies with Section 270528 "Pathways for Communications Systems," and bond both ends of raceway to SBB.
 - 3. Provide TBC and terminate ends to PBB and intersystem bonding busbar at electrical service entrance in accordance with Section 250.94, "Bonding for Communication Systems," of NFPA 70.
 - 4. Busbar Interconnections: Bond SBBs to PBB with TBBs. If more than one TBB is installed, bond TBBs together BBCs where required by TIA-607.
 - 5. Structural Steel: Where structural steel of steel frame building is readily accessible within room or space, bond each SBB and PBB to vertical steel of building frame.

6. Communications Enclosures: Bond metallic enclosures of telecommunications equipment with UBCs to nearest SBB or PBB.
7. Equipment Racks: Bond metallic components of enclosures to RBB using UBCs. Provide top-mounted RBB if not provided by enclosure or rack manufacturer. Bond RBB to SBB with TEBC. Power connection must comply with NFPA 70; equipment grounding conductor in power cord of cord- and plug-connected equipment must be considered supplemental to bonding requirements in this Section.
8. Shielded Cable: Bond shield of shielded cable to SBB in communications rooms and spaces. Comply with TIA-568.1 and TIA-568.2 when grounding shielded balanced twisted-pair cables.
9. Primary Protector: Bond to PBB with insulated bonding conductor.
10. Electrical Power Panelboards: Where electrical panelboards for communications equipment are located in same room or space, bond each ground bar of panelboard to SBB.
11. Cable Trays: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
12. Ladder Racks: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
13. Access Floors: Bond metal parts of access floors to SBB.
14. .

3.5 IDENTIFICATION

- A. Comply with Section 270553 "Identification for Communications Systems."
- B. Labels must be preprinted or computer-printed type.
 1. Label PBB(s) with "ts-PBB," where "ts" is telecommunications space identifier for location of PBB.
 2. Label SBB(s) with "ts-SBB," where "ts" is telecommunications space identifier for location of SBB.
 3. Label TBC, TBBs, and BBCs at attachment points with legend: "WARNING! COMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench according to manufacturer's published instructions.
 2. Test bonding connections of system using AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing PBB or SBB, using process recommended by BICSI N1. Conduct tests with facility in operation.
 - a. Measure resistance between PBB and electrical service intersystem termination point. Maximum acceptable value is 100 m Ω .
 - 1) If measured resistance from electrical service equipment to ground exceeds 5 Ω , notify Architect and include recommendations to reduce resistance to ground.

- b. Measure resistance between SBBs and PBB. Maximum acceptable value is 100 mΩ.
3. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 A, displaying current in increments of 0.01 A at accuracy of plus or minus 2.0 percent.
 - a. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to PBB and to SBBs. Maximum acceptable AC current level is 1 A.

B. Nonconforming Work:

1. Communications bonding will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports.

3.7 PROTECTION

- A. After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Hooks.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Tele-power poles.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1. Allied Tube & Conduit; Atkore International.
 - 2. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
 - 3. Southwire Company, LLC.
- C. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
 - 2. Comply with TIA-569-D.
- D. GRC: Comply with ANSI C80.1 and UL 6.
 - 1. Rigid metal conduit shall be galvanized steel. Connectors and couplings shall be threaded galvanized malleable iron or steel. Locknuts shall be of the type with sharp edges that bite into enclosure where connected. Plastic insulating bushings shall be high temperature type. Sealing bushings shall have galvanized malleable iron locking ring with molded neoprene sealing ring with predrilled holes to accommodate each individual conductor, stainless steel screws and washers, PVC-coated pressure discs, and factory-installed lay-in grounding conductor lugs. Hub fittings shall be 2-piece, insulated throat, liquidtight type of steel or malleable construction.
- E. EMT: Comply with ANSI C80.3 and UL 797.
 - 1. Electrical metallic tubing shall be galvanized steel. Connectors and couplings shall be malleable iron or steel, galvanized or cadmium-plated, compression type. Connectors shall have insulated throats.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- G. 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.
- H. Flexible metal conduit shall be galvanized steel. Connectors shall be of the twist-in, insertion or totally enclosed clamp type, galvanized malleable iron or steel, with insulated throats.
- I. Liquidtight flexible metal conduit shall be extra flexible type, neoprene-jacketed. Connectors shall be watertight, of the twist-in, insertion type, galvanized malleable iron or steel, with insulated throats.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. 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. Allied Tube & Conduit; Atkore International.
 - 2. Dura-Line.
 - 3. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- C. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Rigid nonmetallic conduit shall be rigid polyvinyl chloride, nonburning, high impact. Couplings and connectors shall be rigid polyvinyl chloride, high impact. Cement for connections of conduit shall be approved by the conduit manufacturer.
 - 2. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-D.
- D. RNC: Type EPC-40-PVC Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.
 - 1. VOC Content: 490 Insert value> g/L or less for PVC conduit and fittings.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum riser installation unless otherwise indicated.
- B. 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. Alpha Wire; brand of Belden, Inc.
 - 2. Dura-Line.

- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.
- E. Innerduct liners shall be corrugated high density orange polyethylene with an inner diameter of 1".

2.4 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

2.5 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. 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. MonoSystems, Inc.
 - 2. nVent.
 - 3. Panduit Corp.
 - 4. Wiremold; Legrand North America, LLC.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Non-continuous cable supports shall be available in multiple sizes, styles and materials. Rigid supports shall be equipped with flared edges and pre-configured bend radius controls.
- E. Provide drop wire supports and threaded rod assemblies in areas where structural mounting surfaces are non-functional or inaccessible.
- F. Sling assemblies/cable straps shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance UTP and optical fiber cables. Support slings shall have a static load limit of 100 lbs.
- G. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable.
- H. Select approved non-continuous cable supports suitable for specific installation environments and/or air handling (plenum) spaces.

- I. Multi-Tier Assembly:
 - 1. Utilize manufacturer hardware to allow for multiple tiers of cable supports as indicated on the project drawings.
 - 2. Continuous cable division shall be fully maintained within each open top cable support.
- J. Comply with TIA-569-D.
- K. Galvanized steel.
- L. J shape.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-D.
 - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 - 5. Gangable boxes are prohibited.
- 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. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
 - 1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

2.7 INNERDUCT

A. Rigid Innerduct: Corrugated HDPE duct for installation in ceilings or within a conduit pathway.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Dura-Line
 - b. Endot Industries, Inc.
 - c. Carlon
2. Size: 1"
3. Color: Orange

B. Fabric Innerduct: Continuous, polyester, multi-pocket fabric innerduct, with internal pull tape.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. MaxCell
2. Indoor Textile Innerduct (Riser-listed): Micro, 2-inch, 3-inch and 4-inch single or multi-cell nylon textile innerduct containing 1250lb polyester flat woven pull tape which meets UL2024A for flame propagation and smoke density values for general applications.
3. Plenum-Listed Textile Innerduct: Micro, 2-inch and 3-inch single or multi-cell nylon textile innerduct containing 200lb nylon-resin flat woven pull tape which meets UL2024A for flame propagation and smoke density values for use in air handling spaces.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.

- C. Minimum Pathway Size: 1 inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

- D. Pathway Fittings: Compatible with pathways 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 compression, steel fittings. Comply with NEMA FB 2.10.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- F. Install surface pathways only where indicated on Drawings.

- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA/BICSI 568.
 - 3. TIA-569-D.
 - 4. NECA 101
 - 5. NECA 102.
 - 6. NECA 105.
 - 7. NECA 111.

- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. The approximate locations of outlets are indicated on the Drawings. The exact locations shall be determined during construction. The right is reserved to change the exact location of any outlet box in any room before it is permanently installed, without additional cost to the Owner and as approved by the Architect and/or Engineer.
- I. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- J. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- K. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within 12 inches of enclosures to which attached.
- M. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions or as otherwise directed by structural engineer.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- N. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, , or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- R. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- S. 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.
- T. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- U. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- V. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- X. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

- Y. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- Z. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- AA. 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 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. Raceways shall be installed parallel or at right angles with building walls.
 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.
- BB. Hooks:
1. Follow manufacturer's instructions and recommended industry standards and guidelines.
 2. Must be an independent support structure for the voice/data communication system.
 3. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 4. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 5. Shall be installed using threaded rods secured to the slab above, manufacturer approved clips/clamps secured to structure or wall mounted to support the telecommunications cable infrastructure parallel to the slab throughout the cable plant, unless site conditions dictate a non-parallel installation.
 6. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings,

- luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
7. Space hooks no more than 5 feet o.c.
 8. Provide a hook at each change in direction. Must be routed to follow existing corridors, and parallel or 90 degree angles from all walls and/or the cable tray whenever possible.
 9. Draping cables over other structures in the ceiling is unacceptable. Water pipes, ceiling grid, sprinkler system, electrical supports, air ducts or any other in-ceiling structure may not be used for cable support.
 10. Contractor installed supports shall be used to supplement the main cable support system when any cabling leaves the main support system or is unsupported for more than three feet (3').
- CC. 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.
- DD. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
1. Set outlet boxes for flush-mounted devices to within 0.125" of finished wall.
 2. Adjust mounting heights of boxes in masonry walls to minimize cutting and patching of masonry.
 3. Install outlet boxes in one vertical line when indicated adjacent on the Drawings but at different mounting heights.
 4. Covers on recessed ceiling outlet boxes shall be painted to match the ceiling.
- EE. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
1. Outlet boxes shall not be installed back-to-back. Maintain minimum 24" separation between outlet boxes on opposite sides of rated walls, and minimum 6" separation in nonrated walls.
- FF. 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.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits. Install boxes level, plumb, and square to the structure.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- JJ. Where raceways must pass through structural members, obtain approval from the Architect and/or Engineer regarding location and size of openings prior to drilling. Lateral raceways in masonry shall not exceed 0.75".
- KK. Raceways shall be secured in place and protected to prevent damage to the work during construction. Open ends of raceways shall be taped or capped after installation to prevent entry

of dirt and debris during construction prior to pulling wire. Installation of raceways shall be complete and shall be blown-out and swabbed clear of water and trash prior to pulling wire.

- LL. Rigid metal conduit shall be installed for applications not otherwise specified herein. Rigid metal conduit shall be secured to metal enclosures using hub fittings. Insulated bushings or fittings shall be installed at connections to cabinets and boxes. Terminate stub-ups not attached to enclosures with an insulated throat grounding bushing. Commercial pipe joint compound shall be applied to the male threads on threaded joints and fittings. Connections shall be wrench-tight, and where subject to ground water, rain or spray shall be watertight.
- MM. Service provider raceways shall be installed as indicated on the Drawings and shall be coordinated with the local telephone company or other service provider. Raceways terminated at plywood backboards shall be turned-up out of the floor slab to 12" above the finished floor if routed from below, and turned down and terminated at the top of the backboard if routed from above.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Inspect fire stopping installation by others between building structure and conduit, wire way, and cable tray to verify integrity of installation.
- C. Protect adjacent surfaces from damage during water seal or fire stop installation. Repair any damage.

3.5 INSTALLATION OF INNERDUCT

- A. Protect products from the effects of moisture, UV exposure, corrosion and physical damage during construction.
- B. Select approved innerduct suitable for specific installation environments and/or air handling (plenum) spaces.
- C. Exposed Textile Innerduct Penetrations: Install conduit sleeves or fire barrier sealing systems in all openings where open and exposed textile innerduct passes through fire-rated walls and floors. After installation, install intumescent fire barrier penetration sealing material between textile innerduct and sleeves or fire barrier system.
- D. Raceway Penetrations: After textile innerduct installation, install intumescent fire barrier penetration sealing material between textile innerduct and conduit or wire way at all exposed penetration locations.

- E. When appropriate, use the following cable ties to secure textile innerduct through previously created incisions:
 - 1. Plenum areas: plenum-rated plastic or stainless steel
 - 2. Non plenum areas: Hook and loop style ties (or Velcro)

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

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SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Underground-line warning tape.
 - 2. Signs.
 - 3. Miscellaneous identification products.
 - 4. Labels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. The labeling scheme is intended to comply with the ANSI/TIA-606-C and the owner's standard for labeling and administration of a cable plant. It is the responsibility of the contractor to acquire, understand, and utilize the owner's labeling scheme for all components of the voice data communications system. The final labeling scheme and all other label requirements shall be coordinated and confirmed with the Owner and Engineer.

2.2 LABELS

- A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.

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. Brady Corporation.
 - b. Newell Brands (DYMO).
 - c. Panduit Corp.
 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 3. Marker for Labels:
 - a. Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Newell Brands (DYMO).
 - c. Panduit Corp.
 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.3 SIGNS

A. Laminated-Acrylic or Melamine-Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face .
 - d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- H. Self-Adhesive Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Provide label 6 inches from cable end.
- I. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, composed of the following, in the order listed:
 - 1. Wiring closet designation.
 - 2. Colon.
 - 3. Faceplate number.
- D. Equipment Room Labeling:
 - 1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
 - 2. Patch Panels: Refer to project drawings.
 - 3. Data Outlets: Unless otherwise noted on project drawings label each outlet with a self-adhesive label indicating the following, in the order listed:
 - a. Room number being served.
 - b. Colon.
 - c. Faceplate number.
- E. Backbone Cables: Label each cable with a self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.
- F. Horizontal Cables: Label each cable with a self-adhesive wraparound label indicating the following, in the order listed:
 - 1. Room number.
 - 2. Colon.
 - 3. Faceplate number.
- G. Grounding Equipment: Refer to Section 270526, "Grounding and Bonding for Communications Systems."
- H. Termination Hardware: Refer to Section 271513 "Communications Copper Horizontal Cabling."
- I. Instructional Signs: Self-adhesive labels.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
- K. Equipment and Raceway Identification Labels:
 - 1. Indoor Equipment: Self-adhesive label Laminated-acrylic or melamine-plastic sign.
 - 2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
 - 3. Equipment to Be Labeled:
 - a. Communications cabinets.

- b. Equipment Racks
4. Raceway to Be Labeled:
- a. Riser conduit
 - b. Service entrance conduit.

END OF SECTION 270553

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SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Backboards.
- 2. Boxes, enclosures, and cabinets.
- 3. Power strips.

- B. Related Requirements:

- 1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
- 2. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
- 3. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
- 4. Section 271333 "Communications Coaxial Backbone Cabling" for coaxial data cabling associated with system panels and devices.
- 5. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
- 6. Section 271533 "Communications Coaxial Horizontal Cabling" for coaxial data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. RCDD: Registered communications distribution designer.
- D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- E. TGB: Telecommunications grounding bus bar.
- F. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
 - 2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches, AC grade void-free.
- B. Backboard Paint: Light-colored fire-retardant paint. Paint plywood face and all sides with two coats of paint, do not paint over fire rated stamp.
- C. Mounting: Anchor with 3/8" toggle bolts or concrete expansion anchors, where applicable, and 2" washers on each corner and 4" on center as required on all walls and above door frame of each communications room/space. Install at 6" AFF to 8' 6" AFF with fire rating stamp facing outwards and visible.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Comply with requirements in Section 271116 "Communications Racks, Frames, and Enclosures."

2.3 POWER STRIPS

- A. Comply with requirements in Section 271116 "Communications Racks, Frames, and Enclosures."

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with the latest edition of BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with the latest edition of BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:

1. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
2. If the stamp is painted-over, the contractor shall be required to replace and properly repaint the plywood.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

3.5 CLEANING

- A. Remove dust, dirt, rust, stains, and temporary covers.
- B. Foreign matter shall be blown, vacuumed, or cleaned out of and from new equipment, devices, switches, controls, and panels.
- C. Clean and polish identification plates.
- D. In equipment rooms, clean equipment, conduit and room surfaces from dust and dirt and maintain in a clean condition from date of substantial completion until final completion of work and corrective work.
- E. Remove all excess material from the Project site.

END OF SECTION 271100

SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. 19-inch equipment racks.
2. 19-inch freestanding equipment cabinets.
3. Power strips.
4. Grounding.
5. Labeling.

- B. Related Requirements:

1. Section 271110 "Communications Equipment Room Fittings" for backboards and accessories.
2. Section 270526 "Grounding and Bonding for Telecommunications Equipment" for TMGBs and TGBs.
3. Section 270536 "Cable Trays for Communications Systems" for cable trays and cable tray accessories.
4. Section 271313 "Communications Copper Backbone Cabling" for copper data cabling associated with system panels and devices.
5. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
6. Section 271333 "Communications Coaxial Backbone Cabling" for coaxial data cabling associated with system panels and devices.
7. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
8. Section 271523 "Communications Optical Fiber Horizontal Cabling" for optical-fiber data cabling associated with system panels and devices.
9. Section 271533 "Communications Coaxial Horizontal Cabling" for coaxial data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.

- C. LAN: Local area network.
- D. RCDD: Registered communications distribution designer.
- E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- F. TGB: Telecommunications grounding bus bar.
- G. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.
- B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 .
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- B. UL listed.
- C. RoHS compliant.
- D. Compliant with requirements of the Payment Card Industry Data Security Standard.

2.2 BACKBOARDS

- A. Backboards: Plywood, void-free, AC grade or better, fire-retardant treated, 3/4"D x 48"W x 96"H inches. Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."
- B. Comply with requirements in Section 271100 "Communications Equipment Room Fittings."

2.3 19-INCH EQUIPMENT RACKS

- A. Description: Two- and four- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.
- B. Manufacturers: Subject to compliance with requirements, undefined:
 - 1. CPI Chatsworth Products.
 - 2. Great Lakes Case and Cabinet.
 - 3. Middle Atlantic Products; Legrand North America, LLC.
- C. General Requirements:
 - 1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Material: Extruded steel Extruded aluminum.
 - 3. Finish: Manufacturer's standard, baked-polyester powder coat.
 - 4. Color: Black.
- D. Floor-Mounted Racks:

1. Overall Height: 72 inches.
2. Upright Depth: 3 inches.
3. Two-Post Load Rating: 200 lb.
4. Four-Post Load Rating: 1000 lb.
5. Number of Rack Units per Rack: 45.
 - a. Numbering: Every rack units, on interior of rack.
6. Threads: 10-32.
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

E. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 19-INCH EQUIPMENT CABINETS

A. Description: Manufacturer-assembled four-post frame enclosed by side and top panels and front and rear doors, designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72 inches between rails.

B. Manufacturers: Subject to compliance with requirements, undefined:

1. Chatsworth Products, Inc.
2. Great Lakes Case and Cabinet.
3. Middle Atlantic Products; Legrand North America, LLC.
- 4.
- 5.

C. Accessories

1. Grounding Bar: Vertical, one for each 2-post equipment rack.
 - a. A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."
2. Rack Shelves:
 - a. Fixed shelf for 2-Post Rack
 - 1) Single-Sided
 - 2) Solid

- 3) 12" deep
 - b. Fixed shelf for 4-Post Rack
 - 1) 1U, Adjustable Depth, solid
 - c. Provide one shelf for each 2-Post and 4-Post Rack.
 3. Cage Nuts
 - a. Size: 10-32
 - b. Provide 100 Cage Nuts and Screws for each rack or cabinet with square-punched rails.
 4. Mounting Screws
 - a. Provide 100 mounting screws for each rack or cabinet of the same size as the mounting rail threads.
- D. Cable Management:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Products shall be from the same manufacturer as 2-post and 4-post racks and/or cabinets unless otherwise indicated on drawings.
 4. Vertical cable management panels shall have front and rear channels, with covers.
 5. Vertical cable management panels shall be the same height as the 2-post and 4-post racks.
 6. Width of Vertical cable management panels shall be as indicated on the drawings, but no smaller than 6" wide unless specifically noted on the drawings.
 7. Horizontal cable management panels shall be provided as indicated on the drawings.
 - a. Ring Depth: 2"
 - b. Style: single-sided solid.
 8. Provide horizontal crossover cable manager at top of each relay rack, with a minimum height of two rack units each.
 9. Horizontal cable manager ring depth and adjustment to wall-mount cabinet mounting rails shall be coordinated.

2.5 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Rack mounting.
 3. LED indicator lights for power and protection status.
 4. LED indicator lights for reverse polarity and open outlet ground.

5. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chatsworth Products, Inc. (CPI)
 - b. Geist Manufacturing
 - c. Schneider Electric (APC)

2.6 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.
 1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.
 2. Rack-Mounted Horizontal TGB: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
 3. Rack-Mounted Vertical TGB: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to rack.

2.7 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 270533 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout of communications equipment spaces.
- C. Comply with BICSI ITSIMM for installation of communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Furnish and install a horizontal cable manager below each patch panel in the Rack. Refer to Project Drawings for size of Wire Managers. Horizontal cable managers are not required below angled patch panels.
- G. Outdoor enclosures to be provided with ventilation according to equipment manufacturer's recommendations.

3.2 GROUNDING

- A. Comply with NECA/BICSI 607.
- B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.
- C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.
 1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

- A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 260553 "Identification for Electrical Systems."
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Comply with requirements in Section 270553 "Identification for Communications Systems."

END OF SECTION 271116

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SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.
4. Cabling identification products.
5. Grounding provisions for twisted pair cable.

1.2 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

1.3 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
 - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.4 ACTION SUBMITTALS

- A. General Requirements for submittals:
 - 1. Within 14 days after notice to proceed, submit an anticipated Project Schedule, and a schedule indicating the proposed submission date of each submittal specified herein. Schedule shall anticipate the submittal review time, the possible need for resubmittals, and the time required for fabrication, shipping and integration into the construction sequence. Architect and/or Engineer will advise of any conflicts in reviewing submittals that the proposed schedule presents.
 - 2. Submittals shall be prepared in a line-by-line format corresponding to these Specifications and shall indicate compliance with each requirement specified herein and indicated in the Drawings.
 - 3. Submittals shall be prepared with a table of contents and hyperlinks to the headers of each submitted item.
 - 4. Resubmittals that are required to address review comments shall include a cover transmittal with a written explanation of how each review comment has been addressed.
 - 5. Submittal data for each Specification Section shall be submitted as a single package.
 - 6. Submittals not specifically required, or not complying with the format requirements, will be returned unreviewed.
 - 7. All submittals shall be submitted electronically in PDF format unless stated otherwise.
 - 8. Submittals are required before installation begins. Equipment shall not be ordered and pay requests will not be approved prior to receipt and approval of submittals.
- B. Product Data: For each type of product.
 - 1. Product submittals shall include all equipment, materials and cables being utilized on the project.

2. Data sheets shall clearly indicate the specific model or part number being submitted for review including sizes, color, finishes, and other attributes to adequately allow submitted product to be reviewed.
3. All related system components shall be submitted as part of the same submission (i.e. patch panels, jacks, faceplates, cable, etc.).
4. Indicate manufacturer's installation instructions, where applicable, including any deviations required due to project conditions.
5. Furnish sample products as required for review by Engineer and/or Architect including any assembly mockups.

C. Shop Drawings: Reviewed and stamped by RCDD.

1. Reproductions or electronic versions of design drawings shall not be used in the preparation of shop drawings.
2. Wiring diagrams indicating proposed connections of equipment, equipment types, model numbers, and designations for cables and termination points.
3. Floor plans indicating equipment locations including equipment identification and references to wiring details.
4. Major, coordinated conduit and cable tray pathways.
5. Shop drawings of fabricated or modified units, if any.
- 6.
7. System Labeling Schedules:
 - a. Electronic copy of labeling schedules, in software and format selected by Owner.
8. Cabling administration Drawings and printouts.
9. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications pathways.
 - c. Telecommunications system access points.
 - d. Telecommunications grounding system.
 - e. Telecommunications conductor drop locations.
 - f. Typical telecommunications details.
 - g. Mechanical, electrical, and plumbing systems.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.

1.6 CLOSEOUT SUBMITTALS

- A. Contractor shall submit all cable test results and any test documentation required prior to acceptance by owner.

- B. Subsequent to the installation, and prior to acceptance of the work, the contractor shall prepare and issue record (as-built) drawings, in Adobe PDF and AutoCAD , that reflect the lengths of cables installed, the actual manner and conditions of installation, including all deletions from, additions to or departures from the contract documents. These documents are to include the information outlet station numbers and cable routing where it varies from the original plan.
- C. Provide cable termination schedules for all cables installed under the Work. Schedules shall be in printed form and on CD in Microsoft Excel format.
- D. Provide Operation and Maintenance Manuals including wiring diagrams, parts list, shop drawings and manufacturers' information on all equipment and cables provided under this Work. Provide manuals within fifteen days of systems acceptance.
- E. Upon completion of the work, the contractor shall coordinate with the manufacturer the issuance of a full warranty on the entire copper and fiber optic cable plant including the horizontal cabling for both parts and labor. The cabling contractor at his sole expense will correct any deficiencies determined by the manufacturer.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated:
 - a. Type CMP complying with UL 1685 or Type CMP in listed cable routing assembly.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.
- D. Cable Construction
 - 1. Listed CMR cable: Solid copper conductors with high-density polyolefin insulation and an overall low smoke polyvinyl chloride (PVC) jacket to achieve a riser (i.e., non-plenum) rating by applicable NEC requirements.
 - 2. Listed CMP cable: Solid copper conductors with fluorinated ethylene propylene (FEP)/polyolefin insulation and an overall low smoke PVC jacket to achieve plenum rating by applicable NEC requirements.
 - 3.
 - 4. LC cable: Solid copper conductors with FEP fluoropolymer insulation and overall FEP fluoropolymer jacket to achieve CMP 50 rating by UL standards.
 - 5. Indoor/Outdoor CMP cable: Rated for wet locations with solid copper conductors covered in fluorinated ethylene propylene (FEP)/polyolefin insulation and an overall low smoke PVC jacket to achieve plenum rating by applicable NEC requirements.
 - 6. OSP outdoor cable rated for wet locations: Solid copper conductors with polyolefin insulation, polyolefin fluted center member with flooding compound, and black polyethylene jacket.
- E. Minimum compliant cables are not acceptable.
- F. Copper Clad Aluminum cables are not acceptable.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Berk-Tek, a Leviton Company.
 - 3. General Cable; Prysmian Group North America.
 - 4. Hitachi Cable America Inc.
 - 5. Mohawk; a division of Belden Networking, Inc.
 - 6. Siemon Co.
 - 7. Superior Essex Inc.; subsidiary of LS Corp.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
 - 1. Lead Content: Less than 300 parts per million.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Color shall be as indicated on project drawings; thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Ortronics, Inc.
 - 4. Panduit Corp.
 - 5. Siemon Co. (The).
- C. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 5e Category 6 Category 6a .
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

- E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
 - a. Style: Flat
 - b. Modular type panels utilizing insertable jacks.
 - 1) Provide additional insertable jacks, as needed, to populate all ports on modular panels.
 - c. Universal T568A and T568B wiring labels.
 - d. Labeling areas adjacent to conductors.
 - e. Replaceable connectors.
 - f. 24 or 48 ports as indicated on the project drawings.
 - g. Rear strain-relief bar.
 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
- F. Patch Cords: Factory-made, four-pair cables in lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have color-coded boots for circuit identification.
 2. Modular data patch cords shall meet channel performance requirements specified herein, and shall be 24 AWG, , stranded conductors insulated with solid polyolefin, tightly twisted into individual pairs and jacketed with flame retardant PVC.
 3. Patch cords shall have latch guards to protect against snagging.
 4. Field terminated patch cords are not acceptable.
 5. Patch cords shall be provided as part of the warranted channel solution.
- G. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 2. Standard: Comply with TIA-568-C.2.
 3. Marked to indicate transmission performance.
- H. Modular Plug Terminated Link (MPTL) (Direct Connect)
1. Standard: Conform to TIA-568.2-D, Annex F
 2. Uses: Termination at end device including Wireless Access Points, CCTV Cameras, TV Displays, Projectors, and other devices as indicated on the project drawings.
 3. Use only where specifically indicated on the Project Drawings.
- I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 2. Designed to snap-in to a patch panel or cover plate.
 3. Standard: Comply with TIA-568-C.2.
 4. Marked to indicate transmission performance.

5. Refer to project drawings for exact quantities and configurations.
6. Keystone-Style jacks shall be provided in floor boxes, poke-thru's, modular furniture adapter plates, etc. where required on project drawings.

J. Industrial / Ruggedized Components

1. Specifier: For Hazardous Locations with specific Class X, Division Y classifications, additional specification edits are required.
2. Shall be used in areas containing dust, moisture, vibration, and chemicals as indicated on the project drawings.
3. IP66/IP67 rated.
4. Components include information outlets, Plugs, Patch Cords, Surface Mount Boxes, Stainless Steel faceplates, and other components as required.
5. Install dust caps on all unused ports.

K. Faceplates / Cover Plates:

1. Four port, vertical single gang cover plates designed to mount to single gang wall boxes or as indicated on project drawings.
2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533 "Raceway and Boxes for Electrical Systems" and with Architect.
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
4. Faceplates shall be designed with flush port openings to accept jacks and other configurations indicated on the Drawings.
5. Faceplates shall not extend more than 0.25" from face of wall.
6. Faceplates shall have an integrated label holder with clear plastic cover. Single gang faceplates shall have 2 integrated label holders with clear plastic covers; one shall be above the jacks and one shall be below the jacks. Double gang faceplates shall have 4 integrated label holders with clear plastic covers; two shall be above the jacks and two shall be below the jacks.

L. Modular Furniture Adapter Faceplates

1. Faceplates shall be designed for use within modular furniture.
2. Faceplates shall have an integrated label holder with clear plastic cover.
3. Confirm dimension of furniture knockout with proposed modular furniture adapter to ensure compatibility.
4. Color: black for dark furniture; ivory for light colored furniture; as directed by architect.

M. Floor Box / Poke-Thru Adapter Plates

1. Coordinate with requirements of Division 26 as applicable.
2. Adapter Plates shall accept 8P8C Jack assemblies, A/V Inserts/Connectors and other connectivity as required by project documents.

N. Surface Mount Boxes

1. 1-Port and 2-Port surface mount boxes as indicated on the project drawings.
2. Plenum rated as required.

3. Shall accept jacks from the same manufacturer as other components used throughout the project.

O. Legend:

1. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 CONSOLIDATION POINT (CP)

- A. Consolidation point enclosures shall comply with ANSI/TIA-568.1D-2015, shall be plenum rated, 16 gauge steel, and shall be designed to house hardware necessary to terminate up to 48 Cat-5e and/or Cat-6 connections.
- B. Units shall include knockouts with grommets capable of maintaining plenum rating of the enclosure once the cable has been installed.
- C. Enclosures shall be painted a light color with textured powder paint.
- D. Access doors shall be hinged and lockable and shall be reversible in the field.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
- D. Comply with Section 270536 "Cable Trays for Communications Systems."
- E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. 8P8C Jack assemblies shall be wired per the pin/pair assignments indicated in ANSI/TIA-568.1D-2015 designated T568A configuration.
- C. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Horizontal cables shall be installed in a star topology from each communications outlet to the Telecommunications room serving that area.
 - 4. The length of each horizontal cable from the Telecommunications room to the communications outlet shall not exceed 295'. Coordinate with the conduit and cable tray installation and modify as necessary to ensure distance requirements are not exceeded.
 - 5. Install 110-style IDC termination hardware unless otherwise indicated.
 - 6. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
 - 7. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 8. MUTOA shall not be used as a cross-connect point.
 - 9. Consolidation points may be used only for making a direct connection to equipment outlets:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.
 - 10. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 11. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 12. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 13. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 - 14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 15. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 - 16. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

17. Observe the bending radius and pulling strength requirements of the cables during handling and installation.
18. Provide clutch or shear pin protection for cables during cable pulling to ensure cable pulling tension is not exceeded.
19. Conceal horizontal cables within ceilings and walls.
20. Cables, when not installed in conduit or cable tray, shall be bundled in groups of no more than 48 cables for Category 5e and 6, and no more than 24 cables for Category-6A. Cable bundle quantities exceeding these limits may cause deformation of the bottom cables within the bundle and degrade cable performance. Cable raceways shall not be filled greater than the ANSI TIA-569-A maximum fill for the particular raceway type or 40%.
21. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
22. Provide temporary protection of cables before termination. Cables shall not be left lying on the floor. Bundle and use Velcro or hook and loop tape to provide protection.
23. Provide a 3' service loop at the entrance of conduits that terminate at communications wall outlets.
24. Provide a 10' service loop at the entrance of conduits that terminate at poke-thru's and floor boxes.
25. Provide a 20' service loop above accessible ceiling at all Wireless Access Point locations.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Complete work actions requiring above ceiling access prior to ceiling tile installation.
3. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
4. Cabling routed above ceilings shall be supported with the following methods:
 - a. In cable tray above accessible ceiling, where indicated on drawings.
 - b. In conduit where indicated on drawings. A pull cord (Polyolefin; minimum 210lb Tensile Strength) shall be installed alongside all cables in enclosed raceways, conduits and areas where access is limited.
 - c. On J-hooks and/or Cable Slings, unless otherwise indicated on the Drawings. Cables shall be supported at a maximum of 48 to 60 inch intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
 - d. Cables shall not be attached to ceiling grid, lighting fixture wires or any other MEP system supports.
5. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable long not less than 12 inches in diameter below each feed point.
4. Provide detailed cable run diagrams for cable runs within raised floors, detailing exact locations of cables and their pathways.

F. Installation of Communications Outlets

1. Communications outlets shall be formed from an assembly of faceplates and jacks as indicated on the Drawings.
2. Communications outlets installed in walls shall be installed in a double-gang box, with a single-gang plaster ring, terminating cables from the Telecommunications room as indicated on project drawings.
3. Install outlets straight and perpendicular to walls and ceilings.
4. Secure faceplates with machine screws provided with the faceplate.
5. Label appropriately and cover each label with the clear plastic cover provided with the faceplate.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."

- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- C. Comply with TIA-607-B and NECA/BICSI-607.
- D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Administration Class: Class 1 .
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 3. Cables labeled within the bundle, where label is obscured from view shall not be accepted.
 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection, Channel Performance Tests will not be accepted.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Test equipment shall be of the quality and accuracy required to test and/or measure system performance with the tolerances specified and shall have been calibrated by the manufacturer within the last 12 months, or as specified herein. Equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates available on request.

B. Data for each measurement shall be documented.

1. The test results/measurements shall be submitted in both the test equipment manufacturer's raw data file and searchable PDF format files.
 2. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered in digital format prior to Owner acceptance of the building. This digital format shall include the software tools required to view, inspect, and print any selection of the test reports.
- C. Nonconforming Work:
1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
 3. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- D. Collect, assemble, and submit test and inspection reports.
- E. A representative of the Owner may elect to test 5% of the installed cables. The test results will be compared with the submitted results. In the event that more than 2% of the compared results differ from the submitted results, the Owner may contract with a third-party testing firm to retest 100% of the installation and the cost shall be borne by the Contractor.
- F. Prepare test and inspection reports. Contractor shall furnish test reports in both PDF and source data files.

END OF SECTION 271513

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SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. Fire-alarm control unit (FACU).
4. Manual fire-alarm boxes.
5. System smoke detectors.
6. Duct smoke detectors.
7. Projected beam smoke detectors.
8. Carbon monoxide detectors.
9. Heat detectors.
10. Continuous linear heat detector system.
11. Multicriteria and multisensor fire detectors.
12. Nonsystem smoke detectors.
13. Air-sampling smoke detectors.
14. Fire-alarm notification appliances.
15. Exit-marking audible notification appliances.
16. Firefighters' two-way telephone communication service.
17. Emergency responder radio coverage system.
18. Firefighters' smoke-control system.
19. Fire-alarm graphic annunciators.
20. Fire-alarm remote annunciators.
21. Fire-alarm addressable interface devices.
22. Digital alarm communicator transmitters (DACTs).
23. Fire-alarm radio transmitters.
24. Video smoke detection.

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.
3. Section 284700 "Mass Notification" for mass notification features that are required in addition to fire-alarm system and equipment requirements specified in this Section.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 4. Annunciator panel details as required by authorities having jurisdiction.
 5. Detail assembly and support requirements.
 6. Include voltage drop calculations for notification-appliance circuits.
 7. Include battery-size calculations.
 8. Include input/output matrix.
 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 10. Include performance parameters and installation details for each detector.
 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 - d. Show air-sampling detector pipe routing.
 14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.
 - j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
 3. Obtain certification by NRTL in accordance with NFPA 72.
 4. Licensed or certified by authorities having jurisdiction.

1.9 FIELD CONDITIONS

- A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.

1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Description:

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

- B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

- 1) Manual stations.
- 2) Smoke detectors.
- 3) Duct smoke detectors.
- 4) Carbon monoxide detectors.
- 5) Automatic sprinkler system water flow.
- 6) Fire-extinguishing system operation.

- c. Fire-alarm signal must initiate the following actions:

- 1) Continuously operate alarm notification appliances.
- 2) Identify alarm and specific initiating device at FACU and remote annunciators.
- 3) Transmit alarm signal to remote alarm receiving station.
- 4) Unlock electric door locks in designated egress paths.

- 5) Switch HVAC equipment controls to fire-alarm mode.
 - 6) Activate emergency shutoffs for gas and fuel supplies.
 - 7) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
- 1) Valve supervisory switch.
 - 2) Independent fire-detection and -suppression systems.
 - 3) FACU has lost communication with the network.
- e. System trouble signal initiation must be by one or more of the following devices and actions:
- 1) Open circuits, shorts, and grounds in designated circuits.
 - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator.
- f. System Supervisory Signal Actions:
- 1) Identify specific device initiating event at FACU and remote annunciators.
 - 2) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
- g. Device Guards:
- 1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.
 - a) Factory fabricated and furnished by device manufacturer.
 - b) Finish: Paint of color to match protected device.
- h. Document Storage Box:
- 1) Description: Enclosure to accommodate standard 8-1/2-by-11-inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
 - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
 - 3) Color: Red powder-coat epoxy finish.
 - 4) Labeling: Permanently screened with 1-inch-high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.

- 5) Security: Locked with 3/4-inch barrel lock. Provide solid 12-inch stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

- 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. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
 - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 - h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class B.

- 2) Pathway Survivability: Level 1.
 - 3) Install no more than 50 addressable devices on each signaling-line circuit.
 - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- i. Serial Interfaces:
- 1) One dedicated RS 485 port for central-station operation using point ID DACT.
 - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 3) One USB port for PC configuration.
 - 4) One RS 232 port for air-aspirating smoke detector connection.
 - 5) One RS 232 port for voice evacuation interface.
- j. Stairwell Pressurization: Provide output signal using addressable relay to start stairwell pressurization system. Signal must remain on until alarm conditions are cleared and fire-alarm system is reset. Signal must not stop in response to alarm acknowledge or signal silence commands.
- 1) Pressurization starts when alarm is received at FACU.
 - 2) Alarm signals from smoke detectors at pressurization air supplies have higher priority than other alarm signals that start system.
- k. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- l. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
 - 2) Smoke detectors in elevator machine room.
 - 3) Smoke detectors in elevator hoistway.
- m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- n. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

- o. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- p. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- q. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided.
- r. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
 - 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 - 2) Programmable tone and message sequence selection.
 - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
 - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- s. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
- t. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- u. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
- v. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals must be powered by 24 V(dc) source.
- w. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- x. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- y. Batteries: Sealed lead calcium.

D. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
- 2. Preaction System Functionality:
 - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.3 MANUAL FIRE-ALARM BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
 2. Station Reset: Key- or wrench-operated switch.
 3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
 4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.
 5. Able to perform at up to 90 percent relative humidity at 90 deg F.
 6. Material: Manual stations made of Lexan polycarbonate.
 7. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms; Honeywell International, Inc.
 - b. Notifier; Honeywell International, Inc.
 - c. Silent Knight; Honeywell International, Inc.
 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 268.
 - b. General Characteristics:
 - 1) Detectors must be two-wire type.
 - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White .
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 13) Multiple levels of detection sensitivity for each sensor.
- 14) Sensitivity levels based on time of day.

2.5 DUCT SMOKE DETECTORS

- 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. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Description: Photoelectric-type, duct-mounted smoke detector.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 - b. UL 268A.

2. General Characteristics:
 - a. Detectors must be two-wire type.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
 - g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
 - h. Each sensor must have multiple levels of detection sensitivity.
 - i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Description: Carbon monoxide detector listed for connection to fire-alarm system.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72
 - b. NFPA 720.
 - c. UL 2075.
 2. General Characteristics:
 - a. Mounting: Adapter plate for outlet box mounting.

- b. Testable by introducing test carbon monoxide into sensing cell.
- c. Detector must provide alarm contacts and trouble contacts.
- d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
- e. Locate, mount, and wire in accordance with manufacturer's written instructions.
- f. Provide means for addressable connection to fire-alarm system.
- g. Test button simulates alarm condition.

2.7 MULTICRITERIA AND MULTISENSOR FIRE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Description: Fire-sensing detectors using multiple means of detection.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - c. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. Detector must send trouble alarm if it is incapable of compensating for existing conditions.
 - d. Test button tests sensors in detector.
 - e. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present sensitivity selected.
 - 4) Sensor range (normal, dirty, etc.).
 - f. Detector must have functional humidity range within 10 to 90 percent relative humidity.
 - g. Color: White.
 - h. Comply with UL requirements.
 - i. Sensors (Multisensor Type): Detector must be comprised of four sensing elements including smoke sensor, carbon monoxide sensor, infrared sensor, and heat sensor.

- 1) Smoke sensor must be photoelectric type as described in "System Smoke Detectors" Article.
- 2) Carbon monoxide sensor must be as described in "Carbon Monoxide Detectors" Article.
- 3) Heat sensor must be as described in "Heat Detectors" Article.
- 4) Each sensor must be separately listed in accordance with requirements for its detector type.

2.8 NONSYSTEM SMOKE DETECTORS

2.9 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

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. Fire-Lite Alarms; Honeywell International, Inc.
 - b. Notifier; Honeywell International, Inc.
 - c. Silent Knight; Honeywell International, Inc.
2. Description: Horns, bells, or other notification devices that cannot output voice messages.
3. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - b. General Characteristics:
 - 1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
 - 2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
 - 4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

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. Fire-Lite Alarms; Honeywell International, Inc.
 - b. Notifier; Honeywell International, Inc.
 - c. Silent Knight; Honeywell International, Inc.
2. Performance Criteria:
- a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 1971.
 - b. General Characteristics:
 - 1) Rated Light Output:
 - a) 15/30/75/110 cd, selectable in field.
 - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
 - 3) Mounting: Wall mounted unless otherwise indicated.
 - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
 - 5) Flashing must be in temporal pattern, synchronized with other units.
 - 6) Strobe Leads: Factory connected to screw terminals.
 - 7) Mounting Faceplate: Factory finished, red.

2.10 FIRE-ALARM REMOTE ANNUNCIATORS

- 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. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Performance Criteria:
1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Flush cabinet, NEMA 250, Type 1.

- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

- 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. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Include address-setting means on module.
 - b. Store internal identifying code for control panel use to identify module type.
 - c. Listed for controlling HVAC fan motor controllers.
 - d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
 - e. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

- 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. Fire-Lite Alarms; Honeywell International, Inc.
 2. Notifier; Honeywell International, Inc.
 3. Silent Knight; Honeywell International, Inc.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.

- b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture two telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
- c. Local functions and display at DACT must include the following:
 - 1) Verification that both telephone lines are available.
 - 2) Programming device.
 - 3) LED display.
 - 4) Manual test report function and manual transmission clear indication.
 - 5) Communications failure with central station or FACU.
- d. Digital data transmission must include the following:
 - 1) Address of alarm-initiating device.
 - 2) Address of supervisory signal.
 - 3) Address of trouble-initiating device.
 - 4) Loss of ac supply.
 - 5) Loss of power.
 - 6) Low battery.
 - 7) Abnormal test signal.
 - 8) Communication bus failure.
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- D. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed 30 ft..
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Air-Sampling Smoke Detectors: If using multiple pipe runs, runs must be pneumatically balanced.
- H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

- I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within dwelling or suite, they must be connected so that operation of smoke alarm causes alarm in smoke alarms to sound.
- J. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- M. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.5 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.6 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 3. Smoke dampers in air ducts of designated HVAC duct systems.
 4. Magnetically held-open doors.
 5. Electronically locked doors and access gates.
 6. Alarm-initiating connection to elevator recall system and components.
 7. Alarm-initiating connection to activate emergency lighting control.
 8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 9. Supervisory connections at valve supervisory switches.
 10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 11. Supervisory connections at elevator shunt-trip breaker.
 12. Data communication circuits for connection to building management system.
 13. Data communication circuits for connection to mass notification system.
 14. Supervisory connections at fire-extinguisher locations.
 15. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
 16. Supervisory connections at fire-pump engine control panel.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.8 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 - 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
 - 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 - 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Owner to record training.

3.11 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11