

PROJECT MANUAL



PENDER COUNTY LAW ENFORCEMENT CENTER

BURGAW, NORTH CAROLINA

N.C. DHSR PROJECT # J-368

FID # 220537

ARCHITECT'S PROJECT NO.: 611888

MOSELEYARCHITECTS

ARCHITECT/ENGINEER

CHARLOTTE, NORTH CAROLINA

WITHERSRAVENEL

CIVIL CONSULTANT

CARY, NORTH CAROLINA

FOODESIGN ASSOCIATES

FOOD SERVICE CONSULTANT

CHARLOTTE, NORTH CAROLINA

Construction Documents

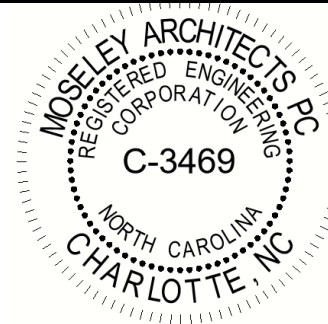
May 1, 2024

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

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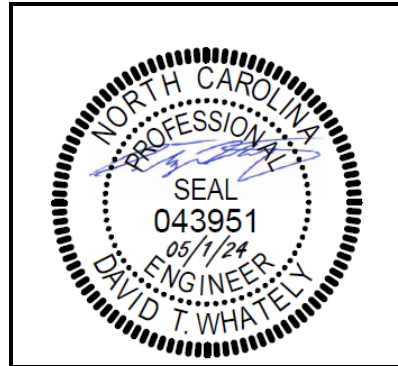
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BURGAW, NORTH CAROLINA
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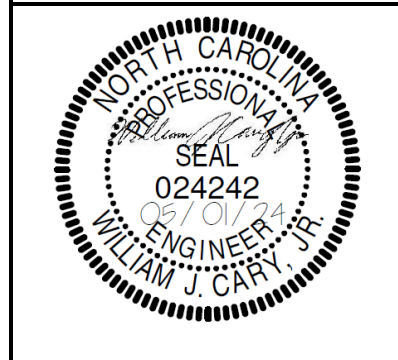


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INVITATION TO BID

Sealed Bids for construction of the **PENDER COUNTY LAW ENFORCEMENT CENTER in Burgaw, North Carolina** shall be received at the **Offices of Pender County, 805 S. Walker Street, Burgaw, NC 28425** (UPS & FedEx and hand delivery); until **2:00 p.m.**, local prevailing time, **June 6, 2024**, and then publicly opened and read immediately thereafter.

Bids received after the announced time and date for submittal, whether by mail or otherwise, will be rejected. Bidders are responsible for ensuring their Bid is received before the deadline indicated. Bids submitted by telephone, email, text message, or facsimile shall not be accepted.

The Project generally consists of a new detention center totaling approximately 104,000 SF. The project is mixed-construction consisting of both Type II-B and Type II-A construction, and mixed occupancy containing Group B, Group I-3 (conditions 3 & 4) and Group S-2 occupancies. There is one alternate to provide additional inmate housing and recreation yard space.

Beginning on **May 6, 2024**, all Bidders may obtain, and/or examine electronic Bidding Documents by visiting www.moseleyarchitects.com and follow the procedure below:

Select the "Bidding" tab at the top of the page, scroll to **Pender County Law Enforcement Center**, click on "Bid Documents", and follow the instructions to "Request a key." Once complete, access to the electronic Bidding Document files can be obtained, saved, and or examined as needed. Addenda for the Project will be posted to the above listed website.

A **mandatory pre-bid conference** will be held at **2:00 p.m.**, on **May 23, 2024, Offices of Pender County, 805 S. Walker Street, Burgaw, NC 28425**. Questions and clarifications may be submitted at this time in writing on the required "Pre-Bid Question Form." The "Pre-Bid Question Form" may be accessed within the Project Manual, or you may submit online via www.moseleyarchitects.com. Follow the same procedure above to navigate to the project and select "Submit a Question." Responses will be in the form of addenda if required.

Refer to the Instructions to Bidders for bidding procedures and requirements. Any questions relating to the Bidding Documents shall be directed to the architect, Moseley Architects, in writing per the procedure above.

Only the following list of General Contractors, selected by Pender County as a result of a pre-qualification process, will be allowed to submit a bid as a Prime Contractor for this project:

Bordeaux Construction Company, Inc., Raleigh, North Carolina
Daniels & Daniels Construction Company, Inc., Goldsboro, North Carolina
H.G. Reynolds Company, Inc., Aiken, South Carolina
T.A. Loving Company, Goldsboro, North Carolina

Pender County reserves the right to reject all bids, to waive informalities and technicalities, and to cancel the Bid Process at any time.

END OF INVITATION TO BID



AIA® Document A701® – 2018

Instructions to Bidders

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

Pender County Law Enforcement Center
Burgaw, North Carolina

THE OWNER:

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

Pender County, North Carolina
Post Office Box 5
805 S. Walker Street
Burgaw, North Carolina 28425

THE ARCHITECT:

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

Moseley Architects P.C.
6210 Ardrey Kell Road
The Hub at Waverly
Suite 425
Charlotte, North Carolina 28277

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.

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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, but are subject to and governed by definitions under applicable laws and regulations.

§ 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~~ in conformance with 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.

§ 1.10 A Responsible Bidder means a person or entity that has the capability, in all respects, to perform fully the Contract requirements and the moral and business integrity and reliability that will assure good faith performance.

§ 1.11 A Responsive Bidder means a person or entity that has submitted a Bid which conforms in all material respects to the Invitation to Bid and requirements of the Bidding Documents.

§ 1.12 An informality means a minor defect or variation of a Bid from the exact requirements of the Invitation to Bid and of the Bidding Documents which does not affect the price, quality, quantity or delivery schedule for the goods, services or construction being procured.

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.

- .7 The Bidder has carefully reviewed the Bidding Documents and has verified that all of the Bidding Documents received are complete. The Bidder shall notify the Architect immediately if received Bidding Documents are not complete.
- .8 The Bidder has familiarized itself with all applicable federal, state and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the Work; the Bidder has obtained the necessary licenses for bidding, if applicable, and is licensed or certified to perform the Work.
- .9 The Bidder shall pay all county, city, state and federal taxes required by laws in effect at the time the Bids are received and resulting from the Work or traceable thereto. Said taxes shall not be in addition to the Contract price between the Owner and the Bidder, as the taxes shall be an obligation of the Bidder and not of the Owner, and the Owner shall be held harmless and indemnified for the same by the Bidder.
- .10 The failure or omission of any Bidder to receive or examine any form, instrument, addendum or other documents, or to acquaint itself with conditions existing at the site(s), shall in no way relieve any Bidder from any obligations with respect to its Bid or to the Contract.
- .11 The Bidder agrees that its Bid shall be based on products and work indicated in the Bidding Documents.

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.~~

§ 3.1.2.1 When the Bidding Documents are returned by the Bidders to the Architect or Owner, the shipping or postage shall be prepaid by the Bidder. The Bidder's deposit will not be refunded if the deposit sum is non-refundable as indicated in the Advertisement or Invitation to Bid.

§ 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.

§ 3.1.4.1 Every Bidder is responsible to review all Bidding Documents received to verify that each set contains a complete set of Contract Documents. Any incomplete Bidding Documents shall be immediately returned to the Architect.

§ 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.

§ 3.3.1.1 The Bidder assumes all risks using a price or bid proposal representing a product or Work that is not indicated in the Bidding Documents and, if the Bidder elects to use that product or Work he shall submit it in accordance with the Division 1 requirements, and as stated herein. If that product or Work is rejected, the Bidder shall provide a product or Work indicated in the Bidding Documents at its cost. The Architect and the Owner shall not consider any requests for additional payments to provide the Work as required by the Contract Documents.

§ 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.)

Copies of the Addendum will be posted electronically and a notice of posting will be sent via facsimile/email to each plan holder of record.

§ 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.

§ 3.4.3.1 Depending on the nature of an Addendum (clarifications, limited scope of revisions, added manufacturers) issued less than four days prior to receipt date, the Architect, in its professional judgment, reserves the right to issue said Addendum without postponement of the bid date. However, if in the professional judgment of the Architect, the information contained in the Addendum would be such that it would be unfair or unreasonable to prepare a bid proposal

based on the revisions in the Addendum, then the bid date will be postponed to allow distribution of the Addendum and time to prepare a bid proposal.

§ 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.~~ Where so indicated by the bid form, all amounts shall be expressed in figures only.

§ 4.1.4 ~~Edits to entries made on paper bid forms must be initialed by the signer of the Bid. All changes made by the Bidder to the bid form or outside of the envelope shall be signed or initialed by the Bidder. Bids containing any conditions, omissions, erasures, alterations, or items not called for in the Bid, may be rejected by the Owner as being incomplete or nonresponsive.~~

§ 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. If the Bidder does not desire to bid on an Alternate, enter the words "No Bid". If the Owner elects to accept an Alternate, all Bidders submitting a "No Bid" for the Alternate selected by the Owner will be ruled nonresponsive and their Bid will not be considered in the award of the Contract. If the Bidder does not enter an Alternate Bid amount, "No Change", or "No Bid" for all requested Alternates, and leaves the Alternate information blank, their Bid will be considered nonresponsive and will not be considered in the award of the Contract.

§ 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:~~ bid security in the form of either a cashier's or certified check or an acceptable Bid Bond in the amount of five percent (5%) of the Bid amount, and made payable to Pender County, North Carolina. The bid security is a guarantee that if the Contract is awarded by the Owner to the Bidder, the Bidder shall enter into the Contract with the Owner for the Work mentioned in this Bid or forfeit the bid security to the Owner, not as a penalty, but as liquidated damages. No forfeiture under a bid security shall exceed the lesser of (i) the difference between the Bid for which the bid security was written and the next low Bid of another Bidder, or (ii) the face amount of the bid security.

(Insert the form and amount of bid security.)

§ 4.2.2 All bonds shall be executed by a surety company selected by the Bidder which is legally authorized to do business in the State of North Carolina, and the bond shall be the same in both form as well as substance as AIA Document A310, Bid Bond. The Bidder shall require the attorney-in-fact, who executed the required bond on behalf of the surety company, to affix thereto a certified and current copy of the power of attorney. The bond premium shall be paid by the Bidder and the cost shall be included in the Bid.

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

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

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

In compliance with N.C.G.S. 143-128 (d) Bidders shall identify on their bid the subcontractors they have selected for the subdivisions or branches of work identified and defined in N.C.G.S. 143-128(a) but briefly referred to as (1) Plumbing, and (2) Mechanical, and (3) Electrical. A Bidder whose bid is accepted shall not substitute any person as subcontractor in the place of the subcontractor listed in the original bid, except (i) if the listed subcontractor's bid is later determined by the Contractor to be nonresponsible or nonresponsive or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work, or (ii) with the approval of the awarding authority for good cause shown by the Contractor. The terms, conditions, and requirements of each contract between the contractor and a subcontractor performing the work under a subdivision or branch of work listed above shall incorporate by reference the terms, conditions, and requirements of the Contract between the Contractor and the Owner.

§ 4.3.2.3 Submit a single copy of the bid form and bid bond.

§ 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.

§ 4.3.6 In the solicitation or awarding of Contracts, the Owner shall not discriminate because of the race, religion, color, sex, age, disability or national origin of the Bidder. The Owner welcomes and encourages the participation of small businesses and businesses owned by women and minorities in procurement transactions made by the Owner.

§ 4.3.7 Trade secrets or proprietary information submitted by a Bidder in connection with a procurement transaction, shall not be subject to public disclosure under the Freedom of Information Act; however, the Bidder must invoke the applicable protection, prior to or upon submission of the data or other materials, and must identify the data or other materials to be protected and state the reasons why protection is necessary. The Owner will not accept responses to the Invitation to Bid

in cases where the Bidder declares the entire response to the Invitation to Bid to be proprietary information. The Bidder must designate, in the smallest increments possible, that part of the Bid which is deemed to be proprietary.

§ 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. A Bid may not be modified, withdrawn or canceled by the Bidder after the time and date designated for the receipt of Bids and for sixty-one (61) calendar days thereafter except as provided in subparagraph 4.4.3 of these Instructions to Bidders and each Bidder so agrees in submitting a Bid.

§ 4.4.1.1 A Bid may be modified or withdrawn by the Bidder any time prior to the time and date set for the receipt of Bids. The Bidder shall notify the Owner in writing of its intentions. Such notice shall be in writing over the signature of the person who submitted the original Bid and the notice shall be received and date and time stamped by the Owner on or before the date and time set for the receipt of Bids.

§ 4.4.1.2 Bidders may indicate modifications to Bid amounts by writing the modification on the outside of the sealed envelope containing the Bid and initialing the modification. Only the Bid amount may be modified by this means; no other qualifications may be made.

§ 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: A Bidder may withdraw its Bid from consideration if the Bid price was substantially lower than other Bids due solely to a mistake therein, provided the Bid was submitted in good faith, and the mistake was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional arithmetic error or an unintentional omission of a quantity of Work, labor made directly in the compilation of a Bid which unintentional arithmetic error or unintentional omission can be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the Bid sought to be withdrawn. If a Bid contains both clerical and judgment mistakes, a Bidder may withdraw its Bid from consideration if the Bid would have been substantially lower than the other Bids due solely to the clerical mistake, that was an unintentional arithmetic error or an unintentional omission of a quantity of Work, labor or material made directly in the compilation of a Bid which shall be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the Bid sought to be withdrawn.

§ 4.4.3.1 The Bidder shall submit to the Owner its original work papers, documents and materials used in the preparation of the Bid within one (1) day after the date fixed for submission of Bids. Such work papers shall be delivered to the Owner by the Bidder in person or by registered mail at or prior to the time fixed by the Owner for the opening of Bids. The Contract shall not be awarded by the Owner until such period has elapsed. Such mistake shall be proved only from the original work papers, documents, and materials delivered to the Owner as required herein.

§ 4.4.3.2 No Bidder who is permitted to withdraw a Bid shall for compensation, supply any material or labor to or perform any subcontract or other work agreement for the person or firm to whom the Contract is awarded or otherwise benefit directly or indirectly from the performance of the Work for which the withdrawn Bid was submitted.

§ 4.4.3.3 If a Bid is withdrawn under authority of this section, the next lowest responsive and responsible Bidder shall be deemed to be the low Bidder.

(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

§ 4.4.3.4 When the procedure set forth in the paragraphs above is utilized, original work papers, documents, and materials used in the preparation of the Bid must be submitted in an envelope or package separate and apart from the envelope containing the Bid marked clearly as to the contents.

§ 4.4.3.5 If the Owner denies the withdrawal of a Bid under the provisions of this section, it shall notify the Bidder in writing stating the reasons for its decision and award the Contract to such Bidder at the Bid price, provided such Bidder is a responsible and responsive Bidder.

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. All Bids received on time in accordance with the Bidding Document requirements shall be opened and publicly read aloud. Any Bidder, upon request, shall be afforded the opportunity to inspect Bid records within a reasonable time after the opening of all Bids but prior to award, except in the event that the public body decides not to accept any of the Bids and to reopen the Contract. Otherwise, Bid records shall be open to public inspection only after award of the Contract. Any inspection of procurement transaction records shall be subject to reasonable restriction to ensure the security and integrity of the records.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or not in conformance with requirements of the Bidding Documents is subject to rejection.

§ 5.3 Acceptance of Bid (Award)

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

§ 5.3.1.1 In determining the lowest responsible Bidder, the Owner may consider, among other things, the Bidder's past performance, conduct on other contracts, and other information provided by the Bidder, including in the Contractor's Pre-Qualification Package, if requested.

§ 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.

§ 5.3.3 In case of a tie Bid, preference may be given to goods, services, and construction produced in Pender County or the State of North Carolina or provided by persons, firms or corporations having principal places of business in Pender County or the State of North Carolina, if such a choice is available; otherwise the tie shall be decided by lot. A Pender County business may be given preference over a State of North Carolinabusiness, if such a choice is available.

§ 5.3.4 If a Contract is to be awarded, the Owner will give the Bidder a Notice of Award within sixty (60) calendar days after the day of the Bid opening.

§ 5.4 NEGOTIATION WITH LOWEST RESPONSIVE AND RESPONSIBLE BIDDER

§ 5.4.1 If award of a Contract to the lowest responsive and responsible Bidder is precluded because of limitations on available funds, the Owner reserves the right to negotiate the Bid amount with the lowest responsive, responsible Bidder to obtain a Contract amount within the available funds. The negotiations may involve changes in either the features or scope of the Work. Such negotiations may include reducing the quantity, quality, or other cost saving mechanisms involving items in the Bid amount, including unit prices (if any) and/or allowances (if any) that affect the Bid amount, and/or Alternates (if any).

§ 5.4.2 The Owner shall notify the lowest responsive and responsible Bidder that such a situation exists and the Owner and Bidder shall then conduct their negotiations in person, by mail, by telephone or by any means they find convenient.

§ 5.4.3 If an acceptable Contract can be negotiated, the changes to the Bid amount and Bidding Documents agreed upon in the negotiations shall be summarized in a "Post Bid Addendum," and included in the Contract.

§ 5.4.4 If the Owner and the lowest responsive and responsible Bidder cannot negotiate a Contract within available funds, the Owner shall terminate negotiations and reject all bids.

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 in writing if either the ~~Owner or Architect, Owner,~~ after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the ~~Owner or Architect~~ has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity. ~~The Bidder may also submit any required entity with an adjustment in the Base Bid or Alternate Bid to account for cover the difference in cost occasioned by such substitution. such substitution, provided such adjustment in cost is justifiable and reasonable.~~ 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~~ has 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.~~ Owner.

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. The successful Bidder shall furnish a Performance Bond covering the faithful performance of the Contract and a Payment Bond covering the payment of all obligations arising thereunder. Each bond shall be written for the full value of the Contract, including all adjustments as authorized by Change Order.~~

§ 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. All bonds shall be written by sureties or insurance companies licensed to do business in the State of North Carolina.~~

~~§ 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. Bond premiums shall be paid by the successful Bidder and the cost shall be included in the Bid price. Any subsequent bond premium costs shall be as authorized by Change Order.~~

~~§ 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 successful 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 along with the signed Contract (Agreement) forms and the required Certificate of Insurance to the Owner within fifteen (15) calendar days after the Notice of Award of the Contract.~~

~~§ 7.2.2 Unless otherwise provided, the The bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Each bond shall be written for the full amount of the Contract.~~

~~§ 7.2.3 The bonds shall be dated on or after the date of the Contract-Contract (Agreement).~~

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

~~ARTICLE 8 — ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS~~

~~ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR~~

~~§ 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, Unless otherwise required in the Bidding Documents, the Contract for the Work will be written on AIA Document A101, 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. Contractor Where the Basis of Payment Is a Stipulated Sum.~~

~~(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~~ **§ 8.2** The Contractor recognize that time is of the essence and that the Owner will suffer financial loss if the Work is not completed by the Substantial Completion date required or as may be amended by the Contract Documents. Contractor recognizes the delays, expenses and damages that are involved in proving in a legal proceeding the actual loss that may be suffered by the Owner if the Work is not completed on time. Accordingly, the Owner and the Contractor agree, stipulate and fix as liquidated damages if delayed, but not as a penalty, the sum indicated on the Bid Form that the Contractor together with the Contractor’s surety shall pay the Owner for each calendar day or part thereof that expires after the date required or as may be amended by the Contract Documents for the Substantial Completion of the Work.

Number	Title	Date
.6	Specifications	

Section	Title	Date	Pages
.7	Addenda:		

Number	Date	Pages
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.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
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.9 Other documents listed below:

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

§ 8.3 The Contractor recognizes that time is of the essence and that the Owner will suffer financial loss if the Work is not completed by the Final Completion date required or as may be amended by the Contract Documents. The Contractor recognizes the delays, expenses and damages that are involved in proving in a legal proceeding the actual loss that may be suffered by the Owner if the Work is not completed on time. Accordingly, the Owner and the Contractor agree, stipulate and fix as liquidated damages if delayed, but not as a penalty, the sum indicated on the Bid Form that the Contractor together with the Contractor’s surety shall pay the Owner for each calendar day or part thereof that expires after the date required or as may be amended by the Contract Documents for the Final Completion of the Work.

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 14:04:00 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A701™ – 2018, Instructions to Bidders, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

SECTION 003132 - GEOTECHNICAL REPORT REQUEST FORM

A geotechnical report has been prepared for this project. Registered bidders who wish to obtain a copy of the report may do so by mailing or emailing this completed request form to Betty Godwin with Moseley Architects, **BGodwin@moseleyarchitects.com**. Requests will only be honored if made on this form with all requested information provided and signature where indicated. **Reports will be sent by email (pdf).**

Please send a copy of the geotechnical report for the **Pender County Law Enforcement Center** to:

(Please print legibly or type)

NAME OF COMPANY: _____

MAILING ADDRESS: _____

E-MAIL ADDRESS: _____

ATTENTION: _____

PHONE NUMBER: _____

By signing this form, I, _____ (*printed name*), as an authorized representative of the above named company, understand and acknowledge the following on behalf of my company:

- The opinions expressed in the geotechnical report are solely those of the Geotechnical Engineer and represent their interpretation of subsurface conditions based on the tests and analyses that they have conducted.
- The information contained in the geotechnical report may not be adequate for my company's purposes during the bidding process and I understand my company is encouraged to perform our own subsurface explorations, examinations, investigations, tests, and analyses prior to bidding to develop our own opinion of the nature of the soil conditions at the Project site.
- Neither the Owner nor the Architect guarantees or warrants the accuracy or completeness of the information in the geotechnical report. The Owner and Architect expressly disclaim any responsibility for whether or not the data in the geotechnical report is representative of the conditions and materials that are actually encountered during construction.
- **The geotechnical report is not part of the Bid Documents and shall not become part of the Contract Documents.**

SIGNATURE: _____

DATE: _____

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

BID FORM

DATE: _____

TO: Pender County, North Carolina
Attn: Meg Blue, Finance Director
P.O. Box 5
805 S. Walker Street
Burgaw, North Carolina 28425
Phone: 910-259-1407
Email: mblue@pendercountync.gov

FROM: _____
Bidder's Name

Bidder's Address

Bidder's Address

FOR: PENDER COUNTY LAW ENFORCEMENT CENTER

Having carefully examined the site, and all of the Bidding and Contract Documents, and in compliance with the "Invitation to Bid," "Instructions to Bidders," and "Supplementary Instructions to Bidders," the undersigned proposes to provide all labor, materials, supplies, equipment, services, and perform all Work necessary for the construction of this Project in accordance with the Bid Documents, dated May 01, 2024, prepared by Moseley Architects.

Complete this Bid Form in blue or black ink or by typewriter. Discrepancies in the multiplications of units of work and the unit prices will be resolved in favor of the correct multiplication of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

BASE BID PRICE:

The Base Bid Price includes all Work required by and in strict accordance with the Bid Documents for this Project, for the Lump Sum of:

\$ _____ (Figures only).

LUMP SUM ALLOWANCES: (Reference Section 012100 Allowances and Section 012110 Sitework Allowances)

- 1. Allowance for Interior/Exterior Signage: **\$15,000.00**
- 2. Allowance for Additional Utility Relocation: **\$20,000.00**

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

QUANTITY ALLOWANCES: (Reference Section 012100 Allowances, 012200 Unit Prices and Section 012110 Sitework Allowances)

1. Quantity Allowance No. 1: Moisture Vapor Treatment:
Estimated quantity of 14,000 s.f. at \$_____ per s.f. (in-place unit price/measure) =
\$_____ (Figures only).
2. Quantity Price Allowance No. 2: Additional Excavation, off-site disposal and backfill with imported structural fill material:
Estimated quantity of 1,500 c.y. at \$_____ per c.y. (in-place unit price/measure) =
\$_____ (Figures only).
3. Quantity Price Allowance No. 3: Additional Excavation, off-site disposal and backfill with imported aggregate base material:
Estimated quantity of 1,500 c.y. at \$_____ per c.y. (in-place unit price/measure) =
\$_____ (Figures only)
4. Quantity Price Allowance No. 4: Backfill with on-site borrow Engineered fill:
Estimated quantity of 1,500 c.y. at \$_____ per c.y. (in-place unit price/measure) =
\$_____ (Figures only)
5. Quantity Price Allowance No. 5: Additional Excavation, trenches and footings:
Estimated quantity of 250 c.y. at \$_____ per c.y. (in-place unit price/measure) =
\$_____ (Figures only)

ADDITIONAL UNIT PRICES: (Reference Section 012110 Sitework Allowances)

6. Unit Price: Woven Geotextile Fabric: _____ per s.y. (in-place unit price/ measure)
7. Unit Price: Non-woven Stabilization Fabric: _____ per s.y. (in-place unit price/ measure)
8. Unit Price: Geogrid: _____ per s.y. (in-place unit price/ measure)

TOTAL BASE BID PRICE

(inclusive of Base Bid Price + all Lump Sum Allowances + all Quantity Allowances) =

\$_____ **Figures**
only.

ADDITIVE ALTERNATES: (Reference Section 012300 Alternates)

1. Add Alternate No. 1: General Population Housing Units C & D:

\$ _____ (Figures only)

2. Add Alternate No. 2: Preferred Manufacturer, Tyco Raven Sprinkler Head:

\$ _____ (Figures only)

3. Add Alternate No. 3: Preferred Manufacturer, Steel Cell of North America:

\$ _____ (Figures only)

4. Add Alternate No. 4: Fire Sprinklers, Wet-Pipe System in Smoke Zones 3 & 4:

\$ _____ (Figures only)

SUB-CONTRACTORS LIST

Bidders Submitting a Single prime Contract are required to list the names of sub-contractors used in determining their bid. List the names of sub-contractors below. (If using separate sub-contractors for the combined bid list both subs and identify the project they are to construct.)

- HVAC:

- Plumbing:

- Electrical:

- Security Control System Contractor:

- Premanufactured Steel Cells:

- Detention Equipment Contractor:

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Under GS 143-128.2(c) the undersigned bidder shall identify on its bid the listed participation forms below. All participation forms must be submitted even if there is no participation.

- _____ Identification of Minority Business Participation Form
- _____ Affidavit A – Listing of Good Faith Efforts
- _____ Affidavit B – Intent to perform contract with own work force.
- _____ Affidavit C – Portion of the work to be performed by minority firms
- _____ Affidavit D – Good Faith Efforts

RECEIPT OF ADDENDA

We acknowledge the receipt of the following Addenda:

Addendum No. _____, dated _____

Addendum No. _____, dated _____

Addendum No. _____, dated _____

Addendum No. _____, dated _____

Addendum No. _____, dated _____

TIME OF COMPLETION

Based upon a Notice to Proceed within **sixty (60)** calendar days from the opening of the bid; Work included in this Contract shall be Substantially Complete no later than **seven hundred (700)** calendar days and finally complete no later than **thirty (30)** calendar days thereafter.

LIQUIDATED DAMAGES

The undersigned agrees, stipulates and fixes as liquidated damages if delayed, but not as a penalty, the sum of Five Hundred Dollars (**\$500.00**) per calendar day that the undersigned together with the undersigned's surety shall pay the Owner for each calendar day or part thereof that expires after the date specified for the Substantial Completion of the Work and until the Work is Substantially Complete. By bidding, the undersigned hereby agrees to be responsible for such liquidated damages.

ACKNOWLEDGMENT AND REPRESENTATIONS

- If notice of acceptance of this bid is given to the undersigned within **sixty (60)** days after the date of opening of bids, or any time thereafter before this bid is withdrawn, the undersigned will execute and deliver the Owner's prescribed modified AIA A101 Architect Agreement promptly after it has been presented to him for signature. Evidence of Insurance pursuant to A201 General Conditions Article 11 and Performance and Payment Bonds and Section 005213.01 Exhibit A shall be furnished to the Owner at the execution of this Agreement.
- Upon request of the Owner, the undersigned Bidder agrees to submit evidence in affidavit form of applicable experience, adequate financial resources, work in hand capacity, adequate organization, and acceptable past performance. Submittal will be in the form of AIA Document A305 Contractor's Qualification Statement. Bidders qualification information shall be considered privileged and confidential.

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

- The undersigned Bidder certifies that neither he/she, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in connection with this bid. The person signing this Bid Form represents that he/she has full authority and representative capacity to execute this Bid Form in the capacity indicated below.
- The undersigned Bidder is a licensed General Contractor in accordance with applicable North Carolina state statutes and regulations, as amended.
- By submitting this bid, Bidder warrants and represents that Contractor and its Subcontractors comply with the E-Verify System requirements for confirmation of employment status of employees per Article 2 of Chapter 64 of North Carolina General Statutes.

CERTIFICATION

I certify that the firm name given below is the true and complete name of the Bidder and that the Bidder is legally qualified and licensed, to perform all Work included in the scope of the Contract.

Legal Name of Bidder (Company) _____

Bidder's (Company) Address _____

Affix Corporate Seal (if applicable):

Corporate
Seal

Signature: _____
(Signature of person(s) legally authorized to bind Bidder (Company) to this Contract)

By: _____
(Typed or printed Name(s) of Person(s) Signing)

Title: _____
(Typed or printed Title(s) of Person(s) Signing)

Telephone Number: _____
(include Area Code)

E-mail: _____
(of person indicated above)

North Carolina General Contractor License No.: _____

(This form may be reproduced in exact detail)

END OF BID FORM



AIA® Document A305® – 2020

Contractor's Qualification Statement

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

SUBMITTED BY: _____ **SUBMITTED TO:** _____
(Organization name and address.) (Organization name and address.)

TYPE OF WORK TYPICALLY PERFORMED

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

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

THIS CONTRACTOR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING:

(Check all that apply.)

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

CONTRACTOR CERTIFICATION

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

Organization's Authorized Representative **Date**
Signature

Printed Name and Title

NOTARY

State of:

County of:

Signed and sworn to before me this day of

Notary Signature

My commission expires:

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 09:06:14 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A305™ – 2020, Contractor's Qualification Statement, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)



AIA® Document A305® – 2020 Exhibit A

General Information

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

§ A.1 ORGANIZATION

§ A.1.1 Name and Location

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

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

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

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

§ A.1.2 Legal Status

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

- .1 If your organization is a corporation, identify the state in which it is incorporated, the date of incorporation, and its four highest-ranking corporate officers and their titles, as applicable.
- .2 If your organization is a partnership, identify its partners and its date of organization.
- .3 If your organization is individually owned, identify its owner and date of organization.

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

- .4** If the form of your organization is other than those listed above, describe it and identify its individual leaders:

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

§ A.1.3 Other Information

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

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

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

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

§ A.2 EXPERIENCE

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

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

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

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

§ A.3 CAPABILITIES

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

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

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

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

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

§ A.4 REFERENCES

§ A.4.1 Identify three client references:

(Insert name, organization, and contact information)

§ A.4.2 Identify three architect references:

(Insert name, organization, and contact information)

§ A.4.3 Identify one bank reference:

(Insert name, organization, and contact information)

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

(Insert name, organization, and contact information)



AIA® Document A305® – 2020 Exhibit B

Financial and Performance Information

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

§ B.1 FINANCIAL

§ B.1.1 Federal tax identification number:

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

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

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

§ B.2 DISPUTES AND DISCIPLINARY ACTIONS

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

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

.1 failed to complete work awarded to it?

.2 been terminated for any reason except for an owners’ convenience?

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

.3 had any judgments, settlements, or awards pertaining to a construction project in which your organization was responsible for more than \$75,000?

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

§ B.2.3 In the last five years, has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management; or any of the individuals listed in Exhibit A Section 1.2:
(If the answer to any of the questions below is yes, provide an explanation.)

.1 been convicted of, or indicted for, a business-related crime?

.2 had any business or professional license subjected to disciplinary action?

.3 been penalized or fined by a state or federal environmental agency?



AIA® Document A305® – 2020 Exhibit C

Project Specific Information

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

PROJECT:

(Name and location or address.)

Pender County Law Enforcement Center
Burgaw, North Carolina

CONTRACTOR’S PROJECT OFFICE:

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

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

TYPE OF WORK SOUGHT

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

CONFLICT OF INTEREST

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

§ C.1 PERFORMANCE OF THE WORK

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

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

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

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

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

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

§ C.2 EXPERIENCE RELATED TO THE PROJECT

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

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

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

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

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

§ C.3 SAFETY PROGRAM AND RECORD

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

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

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

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

§ C.4 INSURANCE

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

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

§ C.4.3 Does your commercial general liability policy contain any exclusions or restrictions of coverage that are prohibited in AIA Document A101-2017, Exhibit A, Insurance A.3.2.2.2? If so, identify.

§ C.5 SURETY

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

§ C.5.2 Surety company name:

§ C.5.3 Surety agent name and contact information:

§ C.5.4 Total bonding capacity:

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



AIA[®] Document A305[®] – 2020 Exhibit D

Contractor's Past Project Experience

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



AIA® Document A305® – 2020 Exhibit E

Contractor's Past Project Experience, Continued

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



AIA® Document A101® – 2017

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

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

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

Pender County, North Carolina
Post Office Box 5
805 S. Walker Street
Burgaw, North Carolina 28425

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

To be determined

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

Pender County Law Enforcement Center
Burgaw, North Carolina

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

Moseley Architects P.C.
6210 Ardrey Kell Road
The Hub at Waverly
Suite 425
Charlotte, North Carolina 28277

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

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

The Owner and Contractor agree as follows.

TABLE OF ARTICLES

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

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

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

(Check one of the following boxes.)

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

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

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

§ 3.3 Substantial Completion

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

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

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

[] By the following date:

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

Portion of Work

Substantial Completion Date

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

ARTICLE 4 CONTRACT SUM

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

§ 4.2 Alternates

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

Item

Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. *(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)*

Item

Price

Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum: *(Identify each allowance.)*

Item

Price

§ 4.4 Unit prices, if any:

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

Item

Units and Limitations

Price per Unit (\$0.00)

§ 4.5 Liquidated damages, if any:

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

§ 4.6 Other:

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

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

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

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than () days after the Architect receives the Application for Payment. *(Federal, state or local laws may require payment within a certain period of time.)*

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

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

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

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

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

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

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

§ 5.1.7 Retainage

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

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

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

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

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

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

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

§ 5.2 Final Payment

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

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

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

§ 5.3 Interest

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

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

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

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

(Check the appropriate box.)

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

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

ARTICLE 7 TERMINATION OR SUSPENSION

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

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

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

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner’s representative:

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

§ 8.3 The Contractor’s representative:

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

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

§ 8.5 Insurance and Bonds

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

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

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

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

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

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

.5 Drawings

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

.6 Specifications

Section	Title	Date	Pages
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.7 Addenda, if any:

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

.8 Other Exhibits:

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

Init.

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

[] The Sustainability Plan:

Title	Date	Pages
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[] Supplementary and other Conditions of the Contract:

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

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

OWNER *(Signature)*

(Printed name and title)

CONTRACTOR *(Signature)*

(Printed name and title)

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 10:29:50 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ – 2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)

SECTION 005213.01
FORM OF AGREEMENT EXHIBIT A – INSURANCE & BOND REQUIREMENTS

ARTICLE 1 CONTRACTOR'S INSURANCE & BONDS

1.01 GENERAL

- A. Contractor shall provide and maintain insurance and bond coverages per the requirements herein, and in accordance with requirements of Article 11 of AIA Document A201. In the event of overlap or conflict, the A201 shall govern.
- B. The Contractor shall provide a summary of insurance coverages on an ACORD 25 Certificate of Insurance (COI) or other industry standard form of certificate.
- C. Form of Bond for Payment and Performance Bonds: Document AIA A312; sample form of bond is included in the Bidding and Procurement documents.
- D. All insurance and bond coverage shall be provided through a company or companies with an "A" or better rating, and licensed in the state where the Project is located.
- E. All General Liability, Automobile, and Umbrella insurance shall designate the Owner, Architect, and Architect's consultants as additional insureds.
- F. General Liability shall not exclude explosion (X), collapse (C), or underground (U) coverages.
- G. Automobile Liability shall include coverage for Owned, Non-Owned, and Hired autos.
- H. The Contractor shall maintain Completed Operations coverage for two (2) years from the date of Substantial Completion.

1.02 INSURANCE COVERAGE LIMITS

- A. The Contractor shall provide the following minimum coverages:
 - 1. Comprehensive General Liability:
 - a. \$1,000,000 – Each Occurrence.
 - b. \$500,000 – Damage to Rented Premises.
 - c. \$10,000 – Medical Expense (Any One Person).
 - d. \$1,000,000 – Personal and Advertising Injury.
 - e. \$2,000,000 – General Aggregate.
 - f. \$2,000,000 – Products and Completed Operations Aggregate Limit.
 - g. \$100,000 – Fire Damage.
 - 2. Comprehensive Business Automobile Liability:
 - a. \$1,000,000 – Each Occurrence.
 - 3. Worker's Compensation: Per statutory limits of the state where the project is located, but not less than \$1,000,000.
 - 4. Employer Liability for Participants not covered by Worker's Compensation:
 - a. \$100,000 – Employer Liability – Each Accident.
 - b. \$100,000 – Employer Liability – Disease – Each Employee.
 - c. \$500,000 – Employer Liability – Disease – Policy Limit.
 - 5. Umbrella Coverage:
 - a. \$1,000,000 - Each Occurrence.
 - b. \$5,000,000 - Aggregate.

6. Builder's Risk:
 - a. New Construction: The Contractor shall insure 100% of the original Contract amount.
7. Pollution:
 - a. \$1,000,000 - Each Occurrence.
 - b. \$2,000,000 - Aggregate.

1.03 BONDS

- A. The Contractor shall provide the following:
 1. Performance Bond: 100 percent of the Contract Sum.
 2. Payment Bond: 100 percent of the Contract Sum.

END OF EXHIBIT A – INSURANCE AND BOND REQUIREMENTS



AIA® Document A312® – 2010

Performance Bond

CONTRACTOR:

(Name, legal status and address)

To be determined

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Pender County, North Carolina
Post Office Box 5
805 S. Walker Street
Burgaw, North Carolina 28425

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

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

CONSTRUCTION CONTRACT

Date:

Amount: \$ 0.00

Description:

(Name and location)

Pender County Law Enforcement Center
Burgaw, North Carolina

BOND

Date:

(Not earlier than Construction Contract Date)

Amount: \$

Modifications to this Bond: None See Section 16

CONTRACTOR AS PRINCIPAL

Company: *(Corporate Seal)*

Signature: _____

Name and

Title:

(Any additional signatures appear on the last page of this Performance Bond.)

SURETY

Company: *(Corporate Seal)*

Signature: _____

Name and

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:**OWNER'S REPRESENTATIVE:**

(Architect, Engineer or other party:)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

- .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and
- .3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

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

§ 14 Definitions

§ 14.1 **Balance of the Contract Price.** The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 **Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 **Contractor Default.** Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 **Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company: _____ (Corporate Seal)

Signature: _____

Name and Title: _____

Address: _____

SURETY

Company: _____ (Corporate Seal)

Signature: _____

Name and Title: _____

Address: _____



Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 12:49:19 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A312™ – 2010, Performance Bond, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)



AIA[®]

Document A312[®] – 2010

Payment Bond

CONTRACTOR:

(Name, legal status and address)

To be determined

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Pender County, North Carolina
Post Office Box 5
805 S. Walker Street
Burgaw, North Carolina 28425

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

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

CONSTRUCTION CONTRACT

Date:

Amount: \$ 0.00

Description:

(Name and location)

Pender County Law Enforcement Center
Burgaw, North Carolina

BOND

Date:

(Not earlier than Construction Contract Date)

Amount: \$

Modifications to this Bond: None See Section 18

CONTRACTOR AS PRINCIPAL

Company: *(Corporate Seal)*

SURETY

Company: *(Corporate Seal)*

Signature: _____

Name and

Title:

(Any additional signatures appear on the last page of this Payment Bond.)

Signature: _____

Name and

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

- .1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
- .2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

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

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

- .1 the name of the Claimant;
- .2 the name of the person for whom the labor was done, or materials or equipment furnished;
- .3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- .4 a brief description of the labor, materials or equipment furnished;
- .5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- .6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- .7 the total amount of previous payments received by the Claimant; and
- .8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

§ 16.4 **Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company: _____ (Corporate Seal)

Signature: _____
Name and Title: _____
Address: _____

SURETY

Company: _____ (Corporate Seal)

Signature: _____
Name and Title: _____
Address: _____

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 12:49:12 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A312™ – 2010, Payment Bond, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Pender County Law Enforcement Center
Burgaw, North Carolina

THE OWNER:

(Name, legal status and address)

Pender County, North Carolina
Post Office Box 5
805 S. Walker Street
Burgaw, North Carolina 28425

THE ARCHITECT:

(Name, legal status and address)

Moseley Architects P.C.
6210 Ardrey Kell Road
The Hub at Waverly
Suite 425
Charlotte, North Carolina 28277

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

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

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User Notes:

(3B9ADA3E)

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13 MISCELLANEOUS PROVISIONS

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User Notes:

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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 Project Manual and 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~~ all Performance by the Contractor shall be ~~required only to the extent~~ consistent with the Contract Documents and reasonably inferable from them as being necessary to

produce the indicated results. Notwithstanding such performance, in case of a conflict, disagreement, or ambiguity, provide the better quality of Work. In case of a conflict, disagreement, or ambiguity, provide the greater quantity of Work.

§ 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.

1.2.1.2 Plumbing, Mechanical, Fire Protection and Electrical drawings are diagrammatic, showing general locations and arrangements of piping, wiring, equipment, security and technology, and specialties; not necessarily showing all required offsets, conditions and appurtenances required for maximum practical accessibility for operation, maintenance and clearances. Coordinate this Work in order to achieve the required and intended Work and notify the Architect immediately of conditions which do not comply or will not allow for this condition.

§ 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~~ Unless otherwise required by the Owner and Architect Agreement, 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,~~ 1.7, 1.8, and 1.9 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~~delivery, including signature of receiver of such notices.

§ 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~~shall 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~~data, should such Exhibit be included in the Agreement.

§ 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.

§ 1.9 If such Exhibits are not included in the Agreement, the Architect may, with the concurrence of the Owner, furnish to the Contractor versions of the Instruments of Service in electronic form. The Contract Documents executed or identified in accordance with Section 1.1.1 shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations involving computers. The Contractor shall not transfer or reuse Instruments of Service in electronic or machine readable form without the prior written consent of the Architect.

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~~ 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 electronic copy of the Drawings, Specifications, and Addenda issued, for the purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3.6.1 At the Architect’s sole discretion, selected electronic (CAD) Drawing files may be made available for use by the Contractor after execution of the Contract for Construction, with the exception of civil grading and layout plans, if authorized by the civil consultant. Such electronic files are not part of the Contract Documents. If available, the Architect shall release them to the Contractor subject to the terms and conditions established by the Architect, to which the Contractor must agree without exception prior to release of the electronic files. Refer to www.moseleyarchitects.com for the Architect’s current Request for Electronic (CAD) Files form, which defines the applicable terms and conditions.

§ 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~~ Amounts charged to the Contractor may, pursuant to Section 9.5.1, 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.

§ 3.1.4 During the performance of this Contract, the Contractor will include the provisions of the foregoing Sections 3.1.4.1 and 3.1.4.2 in every Subcontract or purchase order of over ten thousand dollars (\$10,000.), so that the provisions will be binding upon each Subcontractor or vendor; and furthermore, the Contractor agrees as follows:

- 1 The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.
- 2 The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.
- 3 Notices, advertisements, and solicitations placed in accordance with federal law, rule, or regulation shall be deemed sufficient for the purpose of meeting requirements of this section.
- 4 The Contractor does not, and shall not during the performance of this Contract, knowingly employ an unauthorized alien as defined in the Federal Immigration Reform and Control Act of 1986.**
- 5 Contractor hereby represents it is organized as a stock or non-stock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership and is authorized to transact business in the jurisdiction where the Project is located as a domestic or foreign business entity if so required by Title 13.1 or Title 50 or as otherwise required by law.**

§ 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-~~ 2.3, 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. 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.

§ 3.2.4 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.

§ 3.2.5 The Owner shall deduct from the Contract Sum amounts paid to the Architect for the Architect to evaluate and respond to the Contractor's requests for information, where such information was available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior correspondence or documentation.

§ 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, appropriate~~, 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~~, alternative in writing, 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~~ found to be acceptable 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~~ review by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.2.1 After the Contract has been executed, the Owner and the Architect will consider a formal request for substitution in lieu of those required by the Contract Documents only under and in addition to, the conditions set forth in the Contract Documents. By making requests for substitutions, the Contractor:

- .1 represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to requirements of the Contract Documents;
- .2 represents that the Contractor will provide the same warranty for the substitution that the Contractor is required to provide under the Contract Documents;
- .3 certifies that the cost data presented is complete and includes all related costs under this Contract including the Architect's redesign costs, and waives all claims for additional costs and time related to the substitution which subsequently become apparent; and
- .4 will coordinate and perform the installation of the accepted substitute, making such changes to the Work as may be required for the Work to be complete in all respects.

§ 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.

§ 3.4.4 The Owner shall deduct from the Contract Sum amounts paid to the Architect for the Architect to review the Contractor's proposed substitutions, to make agreed-upon changes in the Instruments of Service, including the Contract Documents, and to provide additional construction phase services made necessary by the Owner's acceptance of such substitutions.

§ 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.

§ 3.7.1.1 Unless otherwise provided in the Contract Documents, the Contractor is responsible for obtaining utilities for the Project and providing the Work relating to Project utilities as indicated. Responsibility for payment of fees associated with providing utilities to the Project shall be as follows:

- .1 Any fees assessed by entities for providing permanent utilities to the Project shall be paid directly to the utility entities by Owner. These include "tap fees" and "electrical connection and service fee." Contractor shall

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- coordinate the permanent utilities and the entity's related work to comply with the construction schedule.
- .2** Any fees assessed by entities for providing temporary utilities to the Project for use by Contractor during construction of the Project shall be paid by the Contractor. The Contractor's payment of fees for temporary utilities shall be included in the Base Bid and Contract Sum and will not be reimbursed by the Owner.

§ 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~~ review 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~~ determine that an equitable adjustment should 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. The Contractor shall identify the date for Owner's selection on the critical path of the Contractor's Construction Schedule and provide the Owner a minimum of two weeks notice before this date.

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§ 3.9 Superintendent and Project Manager

§ 3.9.1 The Contractor shall employ a competent superintendent and project manager and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent and project manager shall represent the Contractor, and communications given to the superintendent or project manager 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 and project manager. Within 14 days of receipt of the information, the Architect-Owner may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or project manager or (2) requires additional time for review. Failure of the Architect-Owner 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 or project manager to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent or project manager without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.9.4 The Superintendent employed by the Contractor shall have a minimum of five (5) years commercial experience as the primary Superintendent on projects of similar size and complexity as the Work. The superintendent shall speak fluent English and clearly understand the English language. The Contractor shall submit to the Owner a resume and other supporting documentation showing that the proposed Superintendent is competent and has the minimum work experience required to execute the Work. The Owner reserves the right to request additional supporting documentation regarding the proposed Superintendent's qualifications and to require the Contractor to propose an alternate Superintendent who better meets the requirements contained in this Article, as may reasonably be determined by the Owner. The Contractor shall notify the Architect and Owner in writing of any proposed replacement of the Superintendent. The Contractor shall not replace a competent Superintendent without prior written approval from the Owner. The requirements contained in this Article shall apply to any proposed replacement Superintendent, regardless if the proposed tenure is to be temporary or permanent.

§ 3.9.5 The Contractor shall employ a Project Manager to be assigned to the Work. The Project Manager employed by the Contractor shall have a minimum of five (5) years commercial experience as Project Manager on projects of similar size and complexity as the Work. The project manager shall speak fluent English and clearly understand the English language. The Contractor shall submit to the Owner a resume and other supporting documentation showing that the proposed Project Manager is competent and has the minimum work experience required to execute the Work. The Owner reserves the right to request additional supporting documentation regarding the proposed Project Manager's qualifications and to require the Contractor to propose an alternate Project Manager who better meets the requirements contained in this Article, as may reasonably be determined by the Owner. The Contractor shall notify the Architect and Owner in writing of any proposed replacement of the Project Manager. The Contractor shall not replace a competent Project Manager without prior written approval from the Owner. The requirements contained in this Article shall apply to any proposed replacement Project Manager, regardless if the proposed tenure is to be temporary or permanent. The Project Manager shall not act as the Superintendent or replacement for the Superintendent without written approval from the Owner.

§ 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~~ Unless otherwise required by the Contract Documents, the schedule shall contain details 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 Substantial Completion date and final completion date indicated in 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~~

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~~be unreasonably delayed or withheld. The~~ in accordance with section 3.12. Unless otherwise required by the Contract Documents, 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~~ accepted submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 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, 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~~ accepted by the Architect or, in the absence of an ~~approved~~ accepted 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~~ accepted by the Architect.

§ 3.12.8 The Work shall be in accordance with ~~approved~~ accepted 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~~ acceptance 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~~ acceptance to the specific deviation in accordance with 3.12.9 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-acceptance~~ thereof.

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

§ 3.12.10 The Contractor shall not be required (delegated design) 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 such delegated 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-provide~~ 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, licensed in the state where the Project is located, 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-provided~~ 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.

§ 3.12.11 The Architect's review of Contractor's submittals will be limited to examination of an initial submittal and one (1) resubmittals. The Architect's review of additional resubmittals will be made only with the consent of the Owner after notification by the Architect. The Owner shall to deduct from the Contract Sum amounts paid to the Architect for evaluation of such additional resubmittals.

§ 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. Such terms as 'Architect-Engineer,' 'Engineer,' and 'A-E,' if used in these Contract Documents, is intended to mean the Architect and its consultants unless otherwise intended by the context or usage of such terms. Such terms do not mean or include any design professional of the Contractor, Subcontractor, or Owner.

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

§ 4.1.3 Subject to the standard of care for applying professional judgment to information used or relied upon, Architect and its Consultants may use and rely upon design elements, technical standards, test results, and all other information ordinarily or customarily furnished or published by others, including, but not limited to, specialty contractors, manufacturers, fabricators, and suppliers.

§ 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~~ general compliance 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.

§ 4.2.2.1 The Contractor shall reimburse the Owner for compensation paid to the Architect for additional site visits made necessary by the fault, neglect or request of the Contractor.

§ 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 endeavor to report to the Owner~~ (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) known 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 general 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.~~ Contractor. 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-acceptance of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval-acceptance of a specific item shall not indicate approval-acceptance of an assembly of which the item is a component.

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§ 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~~ review and make determinations regarding concealed and unknown conditions as provided in Section 3.7.4.

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

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

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

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

§ 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~~ submit to the Owner and Architect ~~of the persons or entities proposed for each principal portion of the Work, Work (list of proposed subcontractors),~~ including those who are to furnish materials or equipment fabricated to a special ~~design~~ design no later than two days prior to the date of the Pre-construction Conference. Include Contractor's License number and Class for each proposed Subcontractor. Within 14 days of receipt of the information, the ~~Architect~~ Owner 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~~ Owner 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 complete 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 shall similarly make available copies of the complete Contract Documents to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

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

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

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

§ 6.2 Mutual Responsibility

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

§ 6.2.2 If part of the Contractor’s Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Owner and 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 Owner and 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~~ responsible between the Owner, Separate Contractors, and Contractor.

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~~ **7.1.1.1** 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~~ **7.1.1.2 A Construction Change**

~~§ 7.3.1~~ Directive shall be used in the absence of total agreement on the terms of a Change Order. 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~~ **7.1.1.2.1** 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~~ **7.2**.

~~§ 7.1.1.2.2~~ 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.

~~§ 7.1.1.2.3~~ 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.

~~§ 7.1.1.2.4~~ 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 opinion, 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.

~~§ 7.1.2~~ 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.

§ 7.3.4-7.1.3 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.

7.1.4 If a change in the Work results in an adjustment to the Contract Sum, the adjustment (increase or decrease) shall be based on the following, unless noted otherwise:

- .1** Material quantities and unit prices (separated into trades; include sales tax).
- .2** Labor costs (raw cost).
- .3** Labor burden, applied to labor only, including but not limited to, worker's compensation and public liability, social security tax, old age and unemployment insurance, union welfare fund and fringe benefits. Contractor shall be required to substantiate the labor burden percentage applied to any change in contract amount. Labor burden percentage shall not exceed 30% in any case.
- .4** Construction equipment cost.
- .5** Overhead and profit combined (on Claims for net increase only), as defined in Section 7.3.11.
- .6** Cost of Premiums for Bonds (for Contractor only). Evidence of additional premium for bond shall be submitted with Claim.
- .7** Extended Overhead Costs (if applicable) which shall be established by pro-rating the value of supervision, temporary facility, and General Conditions and all other direct and indirect costs of Contractor included in the Contract Sum over the number of days included in the Contract Time.

§ 7.2.1 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, forth, a reasonable amount. In such case, and also under Section 7.3.3.3, 7.1.1.2.1.3, 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 7.3.4 shall be limited to the following: data which shall include, at the Architect's sole discretion, a cost breakdown itemized in accordance with the current appropriate Data Book and edition of R. S. Means Company, Inc., or other source of construction industry cost data acceptable to the Architect.

- .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; Overhead shall include, but not be limited to, project management, field office personnel including supervision, superintendence, wages of timekeepers, watchmen and clerks, small tools, incidentals, general office expenses, insurance premiums, and all other expenses not included in "costs."
- .2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed; If the net value of the change results in a credit, the credit given shall be the net cost without overhead or profit (for Contractor, Subcontractor, or
- .3** Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others; Sub-subcontractor). The cost as used herein shall include all items of labor, materials, equipment,
- .4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and and bonds.
- .5** Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5-7.2.2 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.

§ 7.3.8-7.2.3 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.

§ 7.3.10-7.2.4 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.

7.3. In Sections 7.2 and 7.2.1, the amount for overhead and profit combined, included in the total cost to the Owner, shall be based on the following schedule:

- .1 for the Contractor, for Work performed by the Contractor's own forces, 15 percent of the cost.
- .2 for the Contractor, for Work performed by the Contractor's Subcontractors, 5 percent of the amount due the Subcontractors.
- .3 for each Subcontractor involved, for Work performed by that Subcontractor's own forces, 15 percent of the cost.
- .4 for each Subcontractor involved, for Work performed by the Subcontractor's Sub-subcontractor, 5 percent of the amount due the Sub-subcontractor.
- .5 cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.2.
- .6 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs in the manner prescribed above. Where major cost items are changes to Subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization.

§ 7.4 Minor Changes in the Work

~~The~~ In the Architect's opinion, 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.~~ determine and the Owner approves.

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

§ 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,~~ 7.1.1.2.4, 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.

§ 9.3.1.3 Until final completion, the Owner will pay 95% of the amount due the Contractor on account of progress payments.

§ 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.

§ 9.3.2.1 Contractor shall provide invoices, package slips, or other form of supporting data for materials stored on-site claimed on the progress payment, unless it can be verified through on-site observations. Maintain concise bill of materials and label materials stored on-site for ready identification and verification.

§ 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, unless otherwise agreed upon, within seven working 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~~ general conformance 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 general 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~~ is not a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot 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.

§ 9.6.1.1 The Owner may withhold payments to the Contractor notwithstanding the Architect's certification if it is necessary, in the Owner's opinion, to do so to protect the Owner from loss due to any of the reasons set forth in Sections 9.5.1.1 through 9.5.1.7.

9.6.2 Payment of Subcontractors

§ 9.6.2.1 The Contractor shall pay each Subcontractor, no later than seven working 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.

9.6.2.2 Within seven (7) working days after receipt of amounts paid to the Contractor by the Owner for Work performed under this Agreement, the Contractor shall do one of the following:

- a. Pay each Subcontractor for the proportional share of the total payment received from the Owner attributable to the Work performed by the respective Subcontractor under This Agreement; or
- b. Notify the Owner and Architect, and Subcontractor, in writing, of the Contractor's intention to withhold all or part of the Subcontractor's payment with the reason for nonpayment.

9.6.2.3 The Contractor shall pay interest to each Subcontractor on all amounts owed by the Contractor that remain unpaid after seven (7) days following receipt by the Contractor of payment from the Owner for Work performed by the affected Subcontractor under this Agreement, except for amounts withheld as allowed in Section 9.6.8.1. Unless otherwise provided under the terms of this Agreement, for purposes solely of these prompt payment provisions, interest shall accrue at the rate of one percent (1%) per month.

9.6.2.4 In each Subcontract, the Contractor shall include a provision requiring each Subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier Subcontractor (Sub-Subcontractor).

9.6.2.5 The Contractor's obligation to pay interest to a Subcontractor pursuant to the prompt payment provisions is not an obligation of the Owner, and no modification shall be made to this Agreement and no cost reimbursements claim shall be made for the purpose of providing reimbursement by Owner for such interest charge.

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§ 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~~ Unless otherwise agreed upon, the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven working days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven working 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 working 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 fully occupy or utilize the Work for its intended use or designated portion thereof, for its intended use with all of the Work's parts and systems operable as required by the Contract Documents. Only incidental cleaning, if required beyond cleaning needed for the Owner's full occupancy or utilization, may remain for final completion.

§ 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.~~ corrected. 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~~ Architect discloses any item,

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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.

9.8.3.1 The Architect will provide no more than one (1) inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. The Owner shall deduct from the Contract Sum amounts paid to the Architect for any additional inspections.

§ 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 ~~inspect~~ review 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~~ general compliance 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.

9.10.1.1 The Architect will provide no more than one (1) inspections to determine whether the Work or a designated portion thereof has attained final completion in accordance with the Contract Documents. The Owner shall deduct from the Contract Sum amounts paid to the Architect for any additional inspections.

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

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

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

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

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

9.11 LIQUIDATED DAMAGES

9.11.1 The Contractor, and the Contractor's surety shall be liable for and shall pay the Owner the sums stipulated on the Bid Form, if any, as liquidated damages for each calendar day of delay after the date established for Substantial Completion in the Contract Documents until the Work is substantially complete.

9.11.2 The Owner has established this amount as the proper measure of liquidated damages which the Owner will sustain per day by the failure of the Contractor to substantially complete the Work at the stipulated time and it is not to be construed in any sense as a penalty.

9.11.3 In addition to Liquidated Damages, the Contractor shall pay to the Owner the cost of extended architectural and engineering (including Architect's on-site representative(s), if any, on-site) services rendered beginning at 61 days from the date of Substantial Completion required by the Contract, as adjusted if applicable, and continuously until final completion is achieved.

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.~~ Owner.

§ 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~~ may 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~~ working 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

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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~~ **§ 11.2.2 Property Insurance.** 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 as well as subsequent Contract modifications thereto for the entire Work at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

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

§ 11.2.3 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~~ **11.2.4** If the property insurance requires minimum deductibles and such deductibles are identified in the Contract Documents, the Contractor shall pay costs not covered because of such deductibles.

~~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~~

§ 11.2.5 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

~~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~~ **§ 11.2.6** Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies

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providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance.

§ 11.3 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-review~~ 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 review~~ 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 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.expense without change to the contract time.~~

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or Owner 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.expense without change to the contract time.~~

§ 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.

12.2.2.4 If required by the Owner and the Architect and, upon request by the Owner and prior to the expiration of one year from the date of Substantial Completion, the Architect will conduct and the Contractor shall attend a meeting with the Owner to review the facility operations and performance and the Work.

§ 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.~~located.

§ 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.~~expense without change to contract time.

§ 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~~ submitted 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~~ in a timely manner 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 working 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 working 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~~ 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~~ determination by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or

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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, 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~~ determined 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.~~ 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 Sum, Contract Time, or both 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, 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. Time extensions from adverse weather conditions shall not entitle the Contractor to "extended overhead" recovery.

§ 15.1.6.2.1 Weather data utilized to support claims for adverse weather conditions shall be that obtained from the National Oceanic and Atmospheric Administration (NOAA) for the nearest weather station to the Project. Adverse weather conditions are defined as measurable precipitation (MP) of 0.1 " or more, or 1.0" or more of snow or ice pellets, or freezing temperature (FT) for a day (24 hours) when the temperature remains at 32 degrees Fahrenheit or below. Only measurable precipitation (MP) or freezing temperature (FT) shall be permitted to be claimed for any one calendar day. Time extensions for adverse weather conditions shall be cumulative over the duration of the Project time and claims shall not be permitted for days for drying out of rain-soaked soil, snow accumulation, or similar weather-related conditions or resulting Project conditions.

.1 The Contractor agrees that it shall not be entitled to a time extension for normal inclement weather (weather conditions other than "adverse weather conditions") which could have been expected at the Project locale due to

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precipitation or temperature, based upon actual data from the National Oceanic and Atmospheric Administration (NOAA) for the locality closest to the Project for a five-year period preceding the date of the Contract. The Contractor acknowledges and warrants that in making its proposal or bid and Construction Schedule for the Work, it gave due care and consideration to this expected number of calendar days of inclement weather for the locale of the Project and allowed for the impact of normal inclement weather on subsequent Work. During the time of performance, should the expected number of calendar days of normal inclement weather for the locale of the Project be less than originally anticipated by the Contractor and the Owner, at the time of contracting, those days not so affected by normal inclement weather shall be considered float time in the Construction Schedule.

.2 The Contractor agrees that the measure of adverse weather conditions due to MP or FT during the period covered by this Contract shall be the number of days where adverse weather conditions comply with the weather data referenced in subparagraph 15.1.6.2.1.

.3 Extensions of time will be made only for days in which abnormal adverse weather criteria cited in subparagraph 15.1.6.2.1 occur.

.4 If the total calendar days lost due to adverse weather conditions, from the start of the Work at the Project by the Contractor until the principal portions of the Work are enclosed, exceeds the total number of days to be expected to be lost for the same time period, a time extension, if granted, shall only be for the number of calendar days needed to equal the excess number of calendar days lost to such adverse weather conditions.

§ 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 working days after the Claim has been referred to the Initial Decision Maker, subject to Section 15.2.6 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~~ 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 working 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 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 working 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.~~ Either party may, within 30 working days from the date of receipt of an initial decision, or if no decision has been rendered in accordance with Section 15.2.1, 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 working 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 working 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 order.~~

§ 15.3.3 Either party may, within 30 working days from the date that mediation has been concluded without resolution of the dispute or 60 working 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 working days after written 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.

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification 13:38:30 ET on 02/15/2024 under Order No. 4104248195 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ - 2017, General Conditions of the Contract for Construction, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify on its bid (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. Also, list the good faith efforts (Affidavit A) made to solicit minority participation in the bid effort

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (B) to that effect in lieu of Affidavit (A) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit D is not necessary;

OR

If less than the 10% goal, Affidavit (D) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract

NOTE: Bidders must always submit with their bid the Identification of Minority Business Participation Form listing all MB contractors, vendors, and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A or Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid

Identification of Minority Business Participation

I

(Name of Bidder)

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

Firm Name, Address, and Phone #	Work Type	*Minority Category

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

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

State of North Carolina
County of _____

AFFIDAVIT A – Listing of Good Faith Efforts

(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 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 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 _____

SEAL

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

Notary Public _____ My Commission expires _____

State of North Carolina

**--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 Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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__

SEAL

Notary Public _____

My Commission expires _____

State of North Carolina - AFFIDAVIT C -

Portion of the Work to be performed by Minority 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 minority 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 minority business enterprises. Minority 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 required

Name and Phone Number	*Minority 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 (D)

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority 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 _____

SEAL

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

Notary Public _____ My Commission expires _____

State of North Carolina

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 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 HUB certified/ minority business enterprises. Minority 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 required)

Name and Phone Number	*Minority 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 (D)

Examples of documentation that may be 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.

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 _____

SEAL

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

Notary Public _____ My Commission expires _____

**SECTION 011000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Pender County Law Enforcement Center.
- B. Owner's Name: Pender County - North Carolina.
- C. Architect's Name: Moseley Architects of Charlotte, NC.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price (Fixed Sum) as described in the Bidding and Contractual Requirements (Division 00) included in this Project Manual.

1.03 PROFESSIONAL SEALS

- A. Use of Professional Seals on Bidding, Procurement, and Contract Documents: For the purposes of this paragraph, the term "Regulant" refers to the individual who signs and seals parts of the Contract Documents (e.g. the Drawings and Specifications). Certain information has been excerpted verbatim from a source or sources (e.g., UL assemblies, SMACNA details, applicable state/jurisdiction building code) which was considered or used by Regulant in preparing parts of the Contract Documents, as follows:
 - 1. The excerpted information was neither prepared under the direct control nor personal supervision nor created by the Regulant, as it was prepared by the source and owner of the excerpted information.
 - 2. For purposes of bidding, procuring, and performance of the Work, and in any event of conflicts or ambiguities between the excerpted information in the Contract Documents and the requirements of applicable codes and standards, provide the better quality or greater quantity of Work which, at a minimum, complies with the requirements of the applicable codes and standards.
 - 3. Advise Architect immediately upon becoming aware of requirements of the Work which are not consistent with the requirements of the excerpted information.
 - 4. Attribution is acknowledged for information obtained and included herein verbatim from other source or sources.
 - 5. Regulant has taken into consideration and used certain excerpted information from other sources which are applicable to the Contract Documents, and the Regulant indicates by its seal that it is assuming responsibility for its services in use and application of the excerpted information to the requirements of Work, but not for the excerpted information itself which was prepared by others. Regulant does not indicate by its seal that it is responsible for use or application of other information in such source or sources which was not included herein.

1.04 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.
 - 1. Maintain routes of egress and life safety systems for Owner and occupants at all times.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
-

1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Time Restrictions:
 1. Comply with local regulations for hours of work, noise ordinances, and similar requirements.
- D. Utility Outages and Shutdown:
 1. Limit disruption of utility services to hours the building is unoccupied.
 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 3. Prevent accidental disruption of utility services to other facilities.
- E. Controlled Substances: The use of alcohol and drugs is not permitted on the Project site. Provide a designated outdoor smoking area for construction personnel that is at least 30 feet away from the building.

1.06 SPECIFICATION SECTIONS APPLICABLE TO ALL WORK

- A. The provisions of the Owner/Contractor agreement, General Conditions of the Contract, Supplementary Conditions (if any), and all Division 01 sections shall apply to all sections of the Project Manual.

1.07 SECURITY PROVISIONS

- A. Background Check: The Owner requires that a background check be performed on all personnel working on the site. Comply with Owner's requirements for screening service to be used. Maintain a list of all accredited persons, submit a copy to Owner on request.
- B. Identification Badges: Provide identification badges to each person authorized to enter premises. Badge shall include personal photograph, name, employer, expiration date, and an assigned number. Have personnel return badges to Contractor after completion of their portion of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.

1.02 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, unless otherwise agreed to by Owner in writing.
- B. Forms filled out by hand will not be accepted.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- D. Include in each line item, the amount of Allowances specified in this section. For Quantity Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders, with each Application For Payment.
 - 1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Balance to Finish.
 - 9. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
 - 1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

- I. Submit one electronic and three hard-copies of each Application for Payment.
- J. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 013000.
 - 2. Construction progress schedule, revised and current as specified in Section 013000.
 - 3. Partial release of liens from major subcontractors and vendors.
 - 4. Affidavits attesting to off-site stored products.

1.04 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor on AIA Document G710 "Architect's Supplemental Instructions."
- B. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days, unless otherwise indicated in Proposal Request.
- C. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.
- D. For other required changes, Architect will issue a Construction Change Directive, on AIA Document G714, signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
- F. Substantiation of Costs: Provide full information required for evaluation.
 - 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

- G. Execution of Change Orders: Architect will issue Change Orders on AIA Document G701 for signatures of parties as provided in the Conditions of the Contract.
- H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.05 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017000.
- C. Provide evidence and supporting data for the following, as attachments to the Application for Final Payment:
 - 1. AIA G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 2. AIA G707, "Consent of Surety to Final Payment."
 - 3. Settlement of all debts and claims, including liquidated damages, taxes, and fees.
 - 4. Utility meter readings, fuel levels, and similar measurements, as of the date of turn over to the Owner.
 - 5. Certificates for insured products.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

**SECTION 012100
ALLOWANCES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Allowance Proposal: Submit initial proposal for purchase of products and materials, on Change Order form.
- B. Supporting Documentation:
 - 1. Products and Material: Provide invoices and other documents as required, for products and materials indicating quantities, prices, taxes, delivery fees, and other costs.
 - 2. Labor and Installation: Provide time sheets and other documents as required, indicating all on-site Subcontractor costs, including hours worked, quantity or amount of product/material installed, hourly wages, and Subcontractor overhead and profit.

1.02 LUMP-SUM AND QUANTITY ALLOWANCES

- A. Costs Included in Lump-Sum and Quantity Allowances: All Subcontractor's costs: Cost of products and materials, taxes, freight, delivery, receiving and handling, labor and installation, Subcontractor overhead and profit.
- B. Costs Not Included in Lump-Sum and Quantity Allowances: All General Contractor's costs: General coordination, GC's overhead and profit.
- C. Contractor Responsibilities:
 - 1. Assist Architect in selection of products.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
- D. Differences in costs will be adjusted by Change Order.

1.03 LUMP SUM ALLOWANCE SCHEDULE

- A. Lump Sum Allowance No. 1: Include the stipulated sum of \$15,000 for interior and exterior panel signage, as specified in Division 10 Section "Signage."
- B. Lump Sum Allowance No. 2: Include the stipulated sum of \$20,000 for additional utility relocation (unforeseen conditions, over or in addition to any relocation indicated on Drawings).

1.04 QUANTITY ALLOWANCE SCHEDULE

- A. Quantity Allowance No. 1: Include 14,000 square feet of moisture vapor treatment (MVT). Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.
- B. Quantity Allowance No. 2: Include 1,500 cubic yards for excavation of material, where authorized or directed, below or in addition to the levels required for the Work. Dispose of excavated material in an approved location off-site. Backfill with imported structural fill material compacted per specifications. Include in the quantity price the cost of quantity verification by a Surveyor Licensed in the State of North Carolina. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.
- C. Quantity Allowance No. 3: Include 1,500 cubic yards for excavation of material, where authorized or directed, below or in addition to the levels required for the Work. Dispose of excavated material in an approved location off-site. Backfill with imported aggregate base

material compacted per specifications. Include in the quantity price the cost of quantity verification by a Surveyor Licensed in the State of North Carolina. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.

- D. Quantity Allowance No. 4: Include 1,500 cubic yards for backfill with on-site borrow engineered fill. Include in the quantity price the cost of quantity verification by a Surveyor Licensed in the State of North Carolina. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.
- E. Quantity Allowance No. 5: Include 250 cubic yards for excavation of material in trenches and footings, where authorized or directed, below or in addition to the levels required for the Work. Dispose of excavated material in an approved location off-site. Backfill with stone, compacted per specifications. Include in the quantity price the cost of quantity verification by a Surveyor Licensed in the State of North Carolina. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012100

**SECTION 012200
UNIT PRICES**

PART 1 GENERAL

1.01 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.02 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.03 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated on the Drawings or in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the Drawings or individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified via mutual agreement, and by personnel authorized by Owner, if required.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- E. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes; calculate and certify quantities for payment purposes.

1.04 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected Products.

1.05 SCHEDULE OF UNIT PRICES

- A. Unit Price 1: Moisture Vapor Treatment (MVT):
 - 1. Unit Price shall cover providing a surface-applied moisture vapor treatment, to be applied to concrete slabs prior to installation of floor finishes. Unit price shall be measured by the square foot (sq. ft.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- B. Unit Price 2: Additional Excavation, Backfill with Imported Structural Fill.
 - 1. Unit price shall cover removal of unsuitable soil, transportation to off-site disposal, and replacement with imported structural fill material, compacted per specifications. Unit price shall include quantity verification by licensed Surveyor. Unit price shall be measured in

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No.: 611888

cubic yards (cu. yd.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.

- C. Unit Price 3: Additional Excavation, Backfill with Aggregate Base Material.
 - 1. Unit price shall cover removal of unsuitable soil, transportation to off-site disposal, and replacement with aggregate base material, compacted per specifications. Unit price shall include quantity verification by licensed Surveyor. Unit price shall be measured in cubic yards (cu. yd.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- D. Unit Price 4: Backfill with On-Site Borrow Engineered Fill.
 - 1. Unit price shall cover backfill with on-site borrow engineered fill. Unit price shall include quantity verification by licensed Surveyor. Unit price shall be measured in cubic yards (cu. yd.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- E. Unit Price 5: Additional Excavation in Trenches and Footings, Backfill with Stone.
 - 1. Unit price shall cover removal of unsuitable soil from trenches and footings, transportation to off-site disposal, and replacement with stone, compacted per specifications. Unit price shall include quantity verification by licensed Surveyor. Unit price shall be measured in cubic yards (cu. yd.). This unit price shall be provided in coordination with Quantity Allowance; refer to Allowances section for more information.
- F. Unit Price 6: Woven geotextile fabric (for reinforcement), in place. Mirafi 600X or equivalent. Unit price shall be measured in square yards (s.y.)
- G. Unit Price 7: Non-woven fabric for use in stabilization and separation, in place. Mirafi 160N or equivalent. Unit price shall be measured in square yards (s.y.)
- H. Unit Price 8: Suitable geogrid for use in stabilization, in place. Tensar TX160 or equivalent. Unit price shall be measured in square yards (s.y.)

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012200

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.02 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: General Population Units C & D:
 - 1. Base Bid Item: Do not provide additional south cell block wing (Units C & D).
 - 2. Alternate Item: Provide all required construction to add south cell block wing (Units C & D) as indicated on the Contract Documents.
- B. Alternate No. 2: Owner Preferred Manufacturer - Sprinkler Heads:
 - 1. Base Bid Item: Provide sprinkler heads by any manufacturer meeting the requirements of the Contract Documents, per Division 21 Fire Suppression specifications.
 - 2. Alternate Item: Provide sprinkler heads by Tyco Raven.
- C. Alternate No. 3: Owner Preferred Manufacturer - Steel Cells:
 - 1. Base Bid Item: Provide sprinkler heads by any manufacturer meeting the requirements of the Contract Documents, per Division 13 Steel Cell specification.
 - 2. Alternate Item: Provide manufactured steel cells by Steel Cell of North America.
- D. Alternate No. 4: Fire Sprinkler:
 - 1. Base Bid Item: Provide wet-pipe fire Sprinkler system for smoke zones #3 and #4 and associated tiers.
 - 2. Alternate Item: Provide a Pre-action fire sprinkler system for smoke zones #3 and #4 and associated tiers. Air compressors and releasing panels will be located in Mechanical Room 218.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control, such as unavailability, regulatory changes, or unobtainable warranty terms.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- C. Substitutions shall be submitted directly by a General Contractor/prime bidder. Substitutions submitted by a subcontractor, manufacturer, supplier or other entity other than General Contractor are not acceptable and shall be rejected.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. A copy of the Substitution Request Form that shall be used is included at the end of this Section for informational purposes. Request a Word or editable PDF version of the form from the Architect and complete the form digitally; do not complete the form by hand.
 - 2. Contractor's Substitution Request documentation must include the following:
 - a. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.

- 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 4) Description of Substitution.
 - 5) Reason why the specified item cannot be provided.
 - 6) Description of how proposed substitution affects other parts of work.
 - b. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - c. Impact of Substitution: Provide data indicating cost savings to Owner and change in Contract Time due to accepting substitution.
- E. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Architect will consider requests for substitutions for convenience only within 30 days after date of Agreement.
 1. Substitutions for convenience submitted after this time period may or may not be considered, at the Architect's discretion.
 - B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other unanticipated project considerations.
 - D. Substitutions will not be considered under one or more of the following circumstances:
-

1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.

3.03 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.

3.04 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION 012500

Substitution Request Form – Prior to Receipt of Bids

General Information				
Project Name	Pender County Law Enforcement Center			
A/E Project Number	611888			
Specified Product/Item Information				
Specification Title				
Section				
Page				
Article / Paragraph				
Description				
Proposed Substitution Information				
Proposed Substitution				
Reason for not providing specified product/item				
Comparative Data	Attach a point-by-point comparative data list. Include all differences between the proposed substitution and the specified product/item. If not provided, this Request will be rejected.			
Manufacturer				
Manufacturer Address				
Manufacturer Phone				
Manufacturer Representative Email address				
Trade / Model Name				
Model Number				
Installer (if known)				
Installer Address				
Installer Phone				
History	<input type="checkbox"/> New product	<input type="checkbox"/> 2-5 years	<input type="checkbox"/> 5-10 yrs	<input type="checkbox"/> 10 yrs or longer
Proposed substitution affects other parts of the Work	<input type="checkbox"/> Yes		<input type="checkbox"/> No	
If yes, explain				
Proposed Substitution Similar Installation				
Have you used this product/item on any other projects	<input type="checkbox"/> Yes		<input type="checkbox"/> No	
Project				
Project Address				
Architect/Engineer				
A/E Phone				

Owner					
Owner Phone					
Date installed					
Attached Supporting Data					
<input type="checkbox"/> Drawings	<input type="checkbox"/> Product Data/Specs	<input type="checkbox"/> Samples	<input type="checkbox"/> Tests	<input type="checkbox"/> Reports	<input type="checkbox"/>
Entity submitting this Substitution Request certifies all of the following:					
<ul style="list-style-type: none"> Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein. If applicable, proposed substitution shall not adversely affect LEED requirements nor shall it prevent achieving the relative number of applicable LEED point[s] the specified product would have received. Proposed substitution's function, appearance, and quality are equal or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein. Same or superior warranty and/or guarantees shall be furnished for proposed substitution as is required for the specified product/item. Same maintenance service and source replacement parts, as applicable, are available; including local availability. Proposed substitution shall have no adverse effect on other trades. Proposed substitution shall not affect dimensions and functional clearances. Coordination, installation, and changes to the Work as necessary for the accepted proposed substitution shall be complete in all respects. 					
Entity's Information					
Submitted by					
Signed By					
Date					
Email address of Signee above					
Company Name					
Address					
Phone					
Architect / Engineer Review and Action					
<p>If this Substitution request is acceptable, it shall be included in an Addendum. If the proposed substitution is not included in an Addendum, then the proposed substitution was rejected; was not submitted in accordance with the Bidding/Procurement Documents; and/or this Form was not complete. This Form shall be completely filled in to be considered for acceptance.</p> <p>Acceptance of this Substitution request is an acceptance of the manufacturer and product/item only for general conformance with the design concept reflected in the Bidding/Procurement Documents. The A/E has made no attempt to verify specific performance data, or to check details of the proposed substitution as to special features, capacities, physical dimensions, or code and/or regulatory compliance – all of which remain the responsibility of the submitting entity and the Contractor (if not the submitting entity).</p>					

END OF SUBSTITUTION REQUEST FORM

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements: General product requirements.

1.02 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Electronic File Distribution: Upon request, Contractor may be provided electronic files for use in coordination of the Work and preparation of submittals. Contractor shall submit a signed Request Form for Electronic Files, provided by the Architect.
 - 1. Electronic files do not contain all of the information of the Bid Documents or Contract Documents for construction of the Project, and the Architect shall not be responsible for differences between electronic files, Bid Documents, and Contract Documents.

1.03 SUBMITTALS

- A. General Contractor Personnel: Within 15 days after award of Contract, provide a summary of General Contractor's on site personnel. Identify each individual, beginning with project superintendent. List project responsibilities, cell phone number, and email address.
- B. Subcontractors: Within 15 days after award of Contract, provide a summary of all companies and individuals engaged as subcontractors for any part of the Project. Include a contact name, company address, phone number, and email address, and identify what part of the Work shall be completed by each subcontractor.
- C. Coordination Drawings: Submit completed Coordination Drawings for Architect's information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in allowable format.
 - 3. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 - 4. Paper document transmittals will not be reviewed unless previously approved; emailed electronic documents will not be reviewed.

5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: Coordinate method for exchanging files no later than the Preconstruction Meeting. The Architect's Procore service and procedures can be used at no charge. If the Contractor chooses to use a different platform and methodology:
 1. The Architect may reject the methodology or platform proposed and:
 - a. use the Architect's Procore service, or
 - b. the project team will revert to traditional hard-copy exchange;
 2. or the Contractor shall bear the cost of software, licensing, training, etc., for the project team to participate.
- C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive/record copies of files for Owner. If the Project Team uses an alternate platform preferred by the Contractor, the Contractor shall be responsible for distributing archive/record copies of files to Owner and Architect.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor.
 4. Owner's Commissioning Agent.
 5. Major subcontractors, consultants, and others as necessary and appropriate.
- C. Agenda:
 1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.
 8. Site mobilization and utilization.
 9. Other project-specific items on pre-distributed agenda.
- D. Architect shall record minutes and distribute digital copies to Owner, Contractor, and other attendees. Contractor shall be responsible for distribution to subcontractors and other personnel affected by decisions made.

3.03 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN DEVELOPMENT SESSION

- A. Architect will schedule a meeting after Notice of Award.
 - B. Attendance Required:
 1. Owner.
 2. Owner's Commissioning Agent.
 3. Architect.
 4. Mechanical engineer.
-

5. Contractor.
 6. HVAC subcontractor.
 7. Other major subcontractors, consultants, and others as necessary and appropriate.
- C. Agenda:
1. Protection of Materials: Discussion of how and where materials that could impact IAQ will be stored, including but not limited to, the following:
 - a. Insulation.
 - b. Gypsum board.
 - c. Flooring materials.
 - d. Ceiling panels.
 - e. Furnishings.
 - f. Odorous chemicals.
 2. Protection of HVAC: Discussion of how HVAC equipment will be stored installed, and operated during construction.
 3. Pathway Interruption: Discussion of how airflow between construction zones will be limited to prevent the spreading of pollutants from one part of the building to another.
 4. Housekeeping: Discussion of how the building will be kept clean and dry.
 5. Materials Installation Scheduling: Discussion of what wet (odor emitting) materials will be used on the project, in order to schedule their installation before fuzzy (odor absorbing) materials.

3.04 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section. Do not allow installation of affected work to proceed until preinstallation meeting can be held.
 1. Include all preinstallation meetings on the Project Schedule.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect and Owner in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.05 PROGRESS MEETINGS

- A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
 - B. Attendance Required:
 1. Owner.
 2. Architect.
 3. Contractor's superintendent.
 4. Other subcontractors or consultants as required for the specific parts of the Work to be discussed.
 - C. Agenda:
 1. Review minutes of previous meetings.
 2. Review of work progress.
-

3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to the work.
- D. Architect shall record minutes and distribute copies to the Owner, Contractor, and other consultants, Owner's representatives, or other third party attendees. The Contractor shall be responsible for distributing to any affected subcontractors and other personnel.

3.06 CLOSEOUT MEETING

- A. Schedule and administer closeout meeting no later than 30 days before the scheduled Date of Substantial Completion.
- B. Make arrangements for the meeting, prepare agenda with copies for participants, and preside at the meeting.
- C. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor's superintendent.
 4. Major subcontractors.
 5. Other subcontractors or consultants as required.
- D. Agenda:
1. Review closeout requirements and procedures in Division 1 Section "Execution and Closeout Requirements."
 2. Review startup, testing, and adjusting of all systems, including testing/adjusting/balancing and Commissioning,
 3. Coordination of inspections by local authorities having jurisdiction and third party Special Inspectors as required to obtain Certificate of Occupancy.
 4. Coordination of Owner's occupancy and changeover of utilities, insurance, and building keying/lock system.
 5. Procedures for Contractor's Correction Punch List, Architect's Substantial Completion inspection, and Final Correction Punch List.
 6. Delivery, turnover, and storage of maintenance materials, attic stock, special tools, and other non-installed materials.
 7. Coordination of closeout documentation, including demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
 8. Removal of temporary facilities, construction equipment, and tools.
 9. Final cleaning, touchup, restoration, and preventive maintenance.
 10. Coordination of final Applications for Payment.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.07 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 - 1. Date.
 - 2. High and low temperatures, and general weather conditions.
 - 3. List of subcontractors at Project site.
 - 4. Approximate count of personnel at Project site.
 - 5. Major equipment at Project site.
 - 6. Material deliveries.
 - 7. Safety, environmental, or industrial relations incidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (submit a separate special report).
 - 10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
 - 11. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
 - 12. Testing and/or inspections performed.
 - 13. Signature of Contractor's authorized representative.

3.08 COORDINATION DRAWINGS AND COORDINATION CONFERENCE

- A. Coordination Drawings: The Contractor shall prepare coordination drawings of all spaces where utilities, systems, and other components converge or intersect and efficient installation is required to accommodate all components.
 - 1. Prepare coordination drawings of the following spaces, at minimum. Supplement with additional spaces as required by project-specific conditions.
 - a. Above ceilings.
 - b. Vertical chases, shafts, and wall cavities.
 - c. Mechanical and electrical rooms, fire pump room, and other major utility spaces.
 - 2. Provide accurate overall dimensions of components (for example, outside diameters of pipe and conduit, or overall ductwork dimensions including insulation and enclosure thickness).
 - 3. Include accessory components of systems that could cause potential conflicts, such as bracing, slotted channel framing, hangers, and other supports, valve handles, flanges, fittings, cable/wire management trays, and other similar components.
 - 4. Include sequence of installation of all components, materials, and systems.
 - 5. Include means of access to each component, material, or system, for maintenance and repairs.
 - 6. Provide additional coordination drawings as required by individual specification sections.
 - 7. Prepare Coordination Drawings using project-specific information. Do not use photocopies or reproductions of Contract Documents, and do not use standard details or data from manufacturers, suppliers, or other outside parties.
 - 8. Drawing Files: The Contractor may develop coordination drawings using 2D CAD software or with 3D BIM software with clash-detection functionality.

- a. The Architect will furnish original 3D BIM model or 2D DWG files for Contractor's use upon receipt of Architect's "Request Form for Electronic Files". A copy of this form shall be provided to the Contractor upon request.
 - 1) The Architect makes no guarantee to the accuracy of components in electronic files. The Contractor shall coordinate electronic data with the Contract Documents in order to provide final Coordination Drawings.
 - 2) If using 2D files, the Contractor shall prepare drawings in multiple views (for example, RCP and section) to fully represent 3D space, for example plenum heights, wall assembly thicknesses, etc.
- 9. Submittal: Submit Coordination Drawings as a "Submittal for Information." Architect will not approve Coordination Drawings, but will keep on file for use in subsequent coordination and conflict resolution.
- B. Coordination Conference: Schedule and conduct a Coordination Conference prior to beginning construction or rough-in of affected work. Require attendance by all affected trades and installers.
 - 1. Identify the Coordination Conference as a "milestone" date on the Construction Progress Schedule.
 - 2. Advise the Architect of all potential conflicts identified in the Coordination Drawings and at the Coordination Conference.
 - 3. Do not proceed with construction or installation of components, materials, or systems until potential conflicts have been resolved and affected parties have agreed to a remedy.
 - 4. Remedies to address conflicts not identified in the Coordination Drawings, at the Coordination Conference, or otherwise addressed prior to construction or installation of affected components, materials, and systems, or discovery of a non-workable situation not identified or addressed, will not be considered as a basis for delay, time extension, or additional cost to the Contract.

3.09 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Owner.
 - 3. Prepare using software provided by the Electronic Document Submittal Service.
 - 4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is not included.

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1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 016000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to

lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.

1. When the Architect provides a response to an RFI, that RFI shall be closed. If there is additional information required, or a question about the response itself, then another RFI with a new number shall be generated by the Contractor. At no time shall an RFI be "re-opened" or remain open after the Architect has formally responded.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
 - b. Account for a reasonable duration of time to allow for final color selections, approvals, and preparation of final finish schedules (one finish schedule for interior color selections, and one for exterior color selections). This period shall begin upon receipt of all submittals requiring color selection.

3.11 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Design data.
 3. Shop drawings.
 4. Samples for selection.
 5. Samples for verification.
 - B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
 - C. Samples will be reviewed for aesthetic, color, or finish selection.
 - D. Color Selection: In individual specification sections, specific items are identified which require color/finish selections to be made by the Architect from color chart or sample submittals. The Submittal Schedule, prepared according to "Submittal Schedule" paragraph above, shall identify these required color/finish submittals.
 1. Submittals requiring color selection must be submitted by Contractor and approved by Architect for conformance with Contract Documents prior to the start of the color selection process. When the submittals have been approved for conformance with Contract
-

Documents, the process for color selection, presentation of color concepts, Owner approval, and Color Schedule preparation will begin.

2. Interior Color Selections: The Architect will make coordinated selections of colors/finishes for the building interior, present the resulting color concepts to the Owner for approval, and prepare the actual Interior Color Schedule for the Work.
 3. Exterior Color Selections: The Architect will make coordinated selections of colors/finishes for the building exterior and prepare Exterior Color Schedule.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.12 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
1. Certificates.
 2. Test reports.
 3. Inspection reports.
 4. Manufacturer's instructions.
 5. Manufacturer's field reports.
 6. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.13 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.

3.14 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Selection Samples: Submit one set of manufacturer's charts indicating full range of available colors, textures, patterns, and other aesthetic qualities.
- C. Verification Samples: Submit three sets of physical samples. Two sets will be retained by Architect, the third will be returned to the Contractor. Maintain approved sample at the Project site for use in comparing to installed Work.
1. Where a full-size assembly of multiple components is required as a sample (for example, railing section or full-size cabinet), only one sample is required for those items.

3.15 SUBMITTAL PROCEDURES

- A. General Requirements:
1. Use a single transmittal for all submittals required by each individual specification section, unless otherwise indicated.

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- a. Verification samples and large shop drawing submittals may be submitted under separate cover when approved by Architect.
 2. Transmit using AIA G810 or other approved form.
 3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
 7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. Allow sufficient time for administrative processing, Architect's initial review, and potential resubmittals.
 - 1) Large submittals may require longer review durations. Large or multi-part submittals (such as structural steel or aluminum storefront and curtainwall) may be submitted by building area, building level, or otherwise subdivided "packages" with the approval of the Architect. Subdivided "packages" will be reviewed one at a time in the order received. If large submittals are submitted in their entirety as a single package, the Architect may elect to review and return portions of the submittal individually, and will coordinate the schedule for return of these partial reviews with the Contractor for sequencing in the Work.
 - b. Allow additional time for submittals requiring sequential reviews involving Architect's consultants, Owner, or another affected party.
 - c. Allow additional time for submittals requiring sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval.
 - d. No extensions to the project schedule shall be granted due to delays that can be attributed to submittal processing or failure to allow for sequential reviews or resubmittals.
 8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 9. When revised for resubmission, identify all changes made since previous submission.
 10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 11. Incomplete submittals may not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 12. Submittals not requested will be recognized, and will be returned "Not Reviewed".
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
-

1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Selection Samples: Provide color charts that accurately relay color, pattern, and texture information. Photographs or photocopies of color charts are unacceptable and subject to rejection.
 4. Verification Samples: Provide physical samples of each color selected by Architect from Selection Samples. Verification samples shall be manufactured and prepared identically to the material that shall be used in the installed Work. Label each sample clearly with manufacturer, product name, and color, texture, and/or pattern name as applicable. Photographs of physical samples are unacceptable and subject to rejection.

3.16 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt, but will take no other action.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved as Noted":
 - 1) Where review notations indicate revisions are necessary, submit corrected item, with review notations acknowledged and incorporated.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit":
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected/Resubmit":
 - 1) New submittal required, with item complying with requirements of Contract Documents.
 - c. "Color Selection Required":
 - 1) Color selections for the entire project, or portion thereof, will be provided after receipt of all color charts and samples required for the Project.
 - d. "Not Submitted":
 - 1) Additional submittal items are required that were not provided in the original submittal.
- E. Architect's actions on items submitted for information:
1. Items for which no action was taken:

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- a. "Not Reviewed": To notify the Contractor that the submittal has been received for record only.

END OF SECTION 013000

**SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.
- F. Submit in PDF format.

1.02 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.03 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify work of separate phases and other logically grouped activities.
- C. Identify all major milestone dates, including, but not limited to, Notice to Proceed and Substantial and Final Completion dates.
- D. Identify duration of each activity, in maximum 15 day intervals.
- E. Incorporate work restrictions indicated in Section 011000 - Summary, if any.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

- H. Indicate procurement duration and delivery dates for long-lead time items.
- I. Coordinate submittal approval process with procurement and delivery requirements. Submittals requiring resubmission or revision for approval will not be allowed as a basis for schedule impacts.
- J. Indicate delivery dates for owner-furnished products and products identified under Allowances.
- K. Indicate the time period for color selection activity and approval by Owner and Architect, as required per Section 013000 - Administrative Requirements.
- L. Indicate date of changeover from temporary to permanent utilities.
- M. Indicate time periods for Commissioning activities, equipment startup, and testing and balancing.
- N. Provide a reasonable time period prior to the date of Substantial Completion for administrative activities and procedures.
- O. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify critical path activities.
- C. Identify the first work day of each week.

3.04 NETWORK ANALYSIS (CPM)

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
 - 1. Preceding and following event numbers.
 - 2. Activity description.
 - 3. Estimated duration of activity, in maximum 15 day intervals.
 - 4. Earliest start date.
 - 5. Earliest finish date.
 - 6. Actual start date.
 - 7. Actual finish date.
 - 8. Latest start date.
 - 9. Latest finish date.
 - 10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
 - 11. Percentage of activity completed.
 - 12. Responsibility.
- D. Analysis Program: Capable of accepting revised completion dates, and recomputation of all dates and float.
- E. Required Reports: List activities in sorts or groups:
 - 1. By preceding work item or event number from lowest to highest.
 - 2. By amount of float, then in order of early start.

3. In order of latest allowable finish dates.
4. Listing of activities on the critical path.

3.05 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.06 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Schedule revisions shall not modify any Contract Dates or the Contract Sum, unless specifically approved and documented via Change Order.
- G. Submit reports required to support recommended changes.
- H. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.
- I. Recovery Schedule: If the Contractor is 14 or more days behind schedule, in the opinion of the Owner, the Contractor shall prepare a Recovery Schedule, incorporating a reasonable, mutually agreed upon length of time to return the Work to the approved Schedule. The Recovery Schedule shall be prepared to the same level of detail as the original construction progress schedule. Submit the recovery schedule for Owner review; do not proceed until the Owner has approved.
 1. At the end of the recovery period, Owner shall reevaluate construction progress and determine if the Recovery Schedule has been successfully completed. If completed, Owner shall direct the Contractor to proceed with the latest approved Construction Schedule.
 - a. If the Contractor is still behind schedule at the end of the recovery period, the Owner shall direct the Contractor to provide additional schedule revisions to complete the recovery, or may at its option pursue other means of resolution as provided for by the Contract Documents.
 2. Need for and preparation of a Recovery Plan shall not be the basis of additional cost to the Owner or extension of Project Schedule, unless the Contractor can demonstrate that the reason for being behind schedule is no fault of their own.

3.07 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 013216

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 014200 - Definitions and Reference Standards.

1.02 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services/Delegated Design: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.03 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary falsework for support of spanning or arched structures.
 - 5. Temporary foundation underpinning.
 - 6. Temporary stairs or steps required for construction access only.
 - 7. Temporary hoist(s) and rigging.
 - 8. Investigation of soil conditions and design of temporary foundations to support construction equipment.
 - 9. Additional temporary controls as required.

1.04 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Information to Architect if the criteria indicated are not sufficient to perform required design services.

- C. Scope of Design Services/Delegated Design: As required by individual specification sections.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 2. Include required product data and shop drawings.
 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- D. Test Reports: After each test/inspection, require testing agency to promptly distribute digital copy of report to Architect, Owner, Contractor, and others as required.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports:

1. Submit report promptly to Architect for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
3. Qualification Statement: Provide documentation showing testing laboratory is accredited under OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Contractor's Quality Control (CQC) Plan:

1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling, including inspections by authorities having jurisdiction and special inspections.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.
 - 10) Project materials certification.
 - 11) Managerial continuity and flexibility.
 - c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.07 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, comply with the higher quality or quantity, and provide documentation of the conflict to the Architect.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.08 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform Special Inspections and other specified testing indicated in individual specification sections.
- B. Where indicated in individual specification sections, Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency: Testing agency shall comply with requirements of ASTM E 329, and shall be certified through OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).
 - 1. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.

- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mockups: Construct integrated exterior mockups as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- F. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 - 1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
 - 2. Make corrections as necessary until Architect's approval is issued.
- G. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- H. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
 - B. Testing Agency Duties for Contractor-Employed Testing and Inspection Agencies:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 6. Perform additional tests and inspections required by Architect.
-

7. Attend preconstruction meetings and progress meetings.
 8. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 7. Coordinate repairs where testing and inspection has damaged the Work.
- E. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be performed by the same agency. Do not proceed with construction activities that would conceal or cover work needing re-testing or re-inspection.
- F. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, and field quality control requirements as applicable, and to initiate instructions when necessary.
- B. Provide a written report of observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions or Contract Documents. Obtain Owner's approval prior to proceeding with any modifications.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. Contractor may request to restore defective Work or portions of the Work to comply with specified requirements in lieu of replacement. Obtain Owner's approval prior to proceeding with restoration.

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- C. If, in the opinion of Owner, it is not practical to restore or remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION 014000

SECTION 014200
DEFINITIONS AND REFERENCE STANDARDS

PART 1 GENERAL

1.01 SUMMARY

- A. The definitions include in this section supplement, but do not replace, the definitions contained in the General Conditions. In the event of duplication, the General Conditions shall govern.
- B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.
- F. Installer: A Contractor or other entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that specified requirements apply exclusively to tradespeople of the corresponding generic name.
- G. Experienced: When used with the term "Installer," this term means having successfully completed previous work similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with the requirements of local authorities having jurisdiction.
- H. Replace: Provide an acceptable like product or material in place of a missing or unacceptable (rejected) product or material. To "replace" an unacceptable product or material includes its removal and disposal.
- I. Punch List: A written list of unfinished Work and defective Work resulting from inspection and testing to determine whether Substantial Completion has been accomplished. The unfinished Work and defective Work must be finished and corrected to obtain Substantial or Final Completion, in accordance with the General Conditions.
- J. Written or Printed: When used in conjunction with manufacturer's product data or installation requirements, either of these terms may be used to require compliance with manufacturer's current printed and published information.

1.03 REFERENCE STANDARDS

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified, or are required by applicable codes or local authorities having jurisdiction.

- B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 014200

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SECTION 014520 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Condensing units.
 - c. Heat-transfer coils.
 - 3. Testing, adjusting, and balancing existing systems and equipment.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation system.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner or Architect, 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' notice of scheduled meeting time and location.
 - 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.

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- b. The TAB plan.
- c. Needs for coordination and cooperation of trades and subcontractors.
- d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB agent and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports: Within 14 days of completion of balancing work, submit testing and balancing report.
- G. Sample report forms.

1.6 QUALITY ASSURANCE

- A. Agent Qualifications: Agent and agent's representatives shall be certified by either AABC or NEBB. Engineers licensed in Virginia.
- B. The following information shall be submitted as part of the Quality Assurance Submittal:
 1. Provide evidence of satisfactory completion of at least two projects of similar size and scope. **These projects must include an engineered smoke control system that utilizes the same strategy utilized on this project** (pressurization method). Submit the following for each project:
 - a. Completed testing and balancing reports for each project.
 - b. If not included in the testing and balancing report, provide equipment startup checklists for each project.
 - c. Owner contact for each project.
 - d. Design engineer contact for each project.
 - e. Architect contact for each project.
 2. The architect shall determine whether the agent is qualified and the decision shall be final. Re-submittals on behalf of the same company shall not be considered.

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- C. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Set meeting and submit TAB Conference Notification.
 - 1. Minimum Agenda:
 - a. Submittal distribution requirements.
 - b. Contract documents examination report.
 - c. TAB plan.
 - d. Work schedule and project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - D. TAB Reports: Use standard forms from AABC's "National Standards for TAB" or NEBB's "Procedural Standards for TAB of Environmental Systems."
 - E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for TAB of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
 - F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- 1.7 COORDINATION
- A. Coordinate the efforts of work performed under other sections for operation of systems and equipment to support and assist TAB activities.
 - B. Notice: Provide 7 days' notice to the Contractor and Architect for each test. Include scheduled test dates and times.
 - C. Perform TAB after any required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee indicated in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

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- B. Special Guarantee: Provide a guarantee on NEBB or AABC forms stating that NEBB or AABC will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

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, gage 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 supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.

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- 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 strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of 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. 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.
 - 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.

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3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to 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 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

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- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. 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 Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 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 Documents 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 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.
- B. 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.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

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2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, 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.

3.6 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 two-thirds of the distance down the duct from the fan discharge.
 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. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
 - g. 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.

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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 Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. 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 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 the same as described for constant-volume air systems.
 - 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, rpms, 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 MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

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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.

3.8 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
- B. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Airflow.
 3. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:

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1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.10 PROCEDURES FOR SMOKE CONTROL SYSTEM TESTING (*FC-028)

- A.** Before testing smoke control systems, verify that construction is complete and verify the integrity of each smoke control zone boundary. Verify that windows and doors are closed and that applicable gaskets and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B.** Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.
- C.** Measure, adjust, and record airflow of each smoke control system with all fans that are a part of the system operating as intended in design.
- D.** Measure, adjust, and record the airflow of each fan. For ducted systems, measure the fan airflow by duct Pitot-tube traverse.
- E.** After air balancing is complete, perform the following pressurization testing for each smoke control zone in the system:
 1. Verify the boundaries of each smoke control zone.
 2. With the HVAC systems in their normal mode of operation and smoke control not operating, measure and record the pressure difference across each smoke control zone. Make measurements after closing doors that separate the zones. Make one measurement across each door. Clearly indicate the high and low-pressure side of each door.
 3. With the system operating in the smoke control mode and with each zone in the smoke control system activated, perform the following:
 - a. Measure and record the pressure difference across each door that separates the smoke zone from adjacent zones. Make measurements with the doors that separate the smoke zone from the other zones closed. Clearly indicate the high and low-pressure side of the door. Adjust smoke control fans as necessary to achieve the following pressure differentials across the boundaries:
 - 1) Minimum pressure differential: +0.05 in. w.c.
 - 2) Maximum pressure differential: +0.08 in. w.c.
 - b. After testing a smoke zone's smoke control system, return the HVAC systems to their normal operating mode before activating another zone's smoke control system.
- F. Operational Tests:**
 1. Check proper activation of each zoned smoke control system in response to all means of activation, both automatic and manual.

2. Check automatic response to the fire alarm signals received from the building's fire alarm and detection system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zoned smoke control system occurs.
 3. Check and record the proper operation of fans, dampers, and related equipment as outlined below for each separate zone of the smoke control system.
 - a. Fire zone in which smoke control system automatically activates.
 - b. Type of signal that activates a smoke control system, such as sprinkler water flow, space smoke detector, or duct mounted smoke detector.
 - c. Fan(s) "ON" as required to start the smoke control system.
 - d. Fan(s) or unit(s) "OFF" as required to start smoke control system.
 - e. Auxiliary functions to achieve the smoke control system configuration such as changes or overrides of normal operating sequences.
 - f. Test to verify that the system functions while operating under both normal and standby power.
 - G. Demonstrate by the use of a smoke puffer that smoke moves in the correct direction.
 - H. Provide smoke machine capable of filling typical smoke control zone for use during Department of Corrections system operation demonstration.
 - I. Prepare a complete report of observations, measurements, and deficiencies.
- 3.11 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: 0 to plus 10 percent.
 2. Air Outlets: Plus or minus 10 percent.
 3. Return Inlets: Plus or minus 10 percent.
 4. Exhaust Inlets: 0 to plus 10 percent.
 5. Heating-Water Flow Rate: Plus or minus 10 percent.
 6. Cooling-Water Flow Rate: Plus or minus 10 percent.
 7. Unless indicated otherwise: Plus or minus 10 percent.
 - B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 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 systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

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- B. Status Reports: Prepare monthly 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.

3.13 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. 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 and pump performance forms including the following:

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- a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air 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. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.

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- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. 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.
 - f. Make and model number.
 - g. Face area in square feet.
 - 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.
- o. Inlet steam pressure in psig.

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.

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- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total 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 square feet.
 - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):

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- 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 rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- 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 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 square feet.

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- 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 square feet.

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.

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3.14 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.
- B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 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 testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, 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.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.15 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.
- C. When requested, provide up to 32 hours by the technician that provided services under this Section to support commissioning.

END OF SECTION 014520

**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls, in compliance with local authority having jurisdiction.
- B. Maintain temporary facilities in operable condition.

1.02 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. New permanent facilities may be used, with prior Owner authorization.
 - 1. Use of permanent facilities shall not impact specified warranties. Equipment shall be maintained during temporary usage.
- C. Temporary Lighting: Provide temporary lighting of type and producing lighting levels necessary for proper installation of the Work.
- D. Temporary Heating, Cooling, and Ventilation: Provide temporary measures and equipment as required for curing, drying, and humidity control. Comply with manufacturer's installation instructions for specific product requirements.
 - 1. Provide measures and equipment to meet warranty requirements of interior woodwork specified in Division 6 and/or Division 12 sections.
 - 2. Use of Permanent HVAC Facilities and Equipment: Use of HVAC equipment shall be subject to Owner approval.
 - a. Protect new HVAC equipment from intrusion of dust, silica, dirt and debris during construction operations.
 - b. Cover all openings in new inactive ductwork during construction operation with minimum 6 mil polyethylene sheet.
 - c. Where use of in-place HVAC equipment is approved by Owner, provide temporary filters with a minimum MERV of 8. Change the filters every two weeks while construction is ongoing. Provide new filters at Substantial Completion; do not change out temporary filter until approved by Architect.
 - d. Do not perform testing and balancing of HVAC equipment until dust, silica, dirt and debris producing activities are complete.
- E. Temporary Water: For the duration of construction or until permanent water service is available at the site, the Contractor shall provide a temporary water source, as part of the Contract Price.
- F. Temporary Electric Service: Until electric utility provides permanent service at the site, the Contractor shall provide temporary electrical power, as part of the Contract Price.
- G. Temporary Sewer and Drainage: Comply with requirements of local authority having jurisdiction for connection of temporary sewer to public system.

1.03 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Telephone Service: Contractor shall ensure that all of its forces, including on-site managers/supervisors of each Subcontractor, have mobile devices and adequate voice

- and data coverage for on-site operations.
- 2. Internet Connections: Minimum of one; DSL modem or faster.
- 3. Video Conferencing and Video Site Visit/Walkthrough Infrastructure: Maintain personal computer/laptop with large format display screen and video conferencing software in the common-use field office.
 - a. Maintain equipment in common-use field office for site visits and walkthroughs, including a portable, high quality digital video camera, audio headset with microphone for walkthrough commentary/narration, and accessories including connection cables and battery packs.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
 - 1. Provide temporary unisex toilet units and all required disposable supplies.
 - 2. Provide handwash stations and hand sanitizer at each toilet unit.
 - 3. Provide regular servicing of portable facilities by professional servicing company; including draining, cleaning, and disinfecting.
- B. New permanent facilities may not be used during construction operations.
- C. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect in-place facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way, and for emergency egress.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Barrier Mesh Fence: Provide minimum 6-foot height open-mesh polypropylene barrier fabric mounted on lumber or galvanized steel posts to isolate and define construction area and prevent accidental public access.
- B. Construction: Commercial grade chain link fence.
 - 1. Contractor may provide either fixed or portable fencing to suit conditions. For portable fencing, provide concrete or galvanized steel bases for supporting posts. Bases for portable fencing shall not obstruct sidewalks or other pathways used by pedestrians.
- C. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.
- D. Unless otherwise indicated, provide barrier mesh fencing to enclose the approximate extent of the entire construction site. Chain link fencing shall be used to enclose Contractor's field office and laydown/storage areas, areas of the site actively in construction, and as deemed necessary by Contractor.

1.07 EXTERIOR ENCLOSURES

- A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent

entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

- A. Provide temporary partitions to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to in-place materials and equipment.
- B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with in-place surfaces.

1.09 SECURITY

- A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.
- C. Environmental Protection: Comply with EPA, OSHA and other regulatory requirements to prevent contamination of site, air, and public sewer/runoff.
 - 1. Provide additional work restrictions and protective measures as indicated on Civil/Site Drawings and as specified in Section 011000 - Summary.

1.10 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Designated existing on-site roads may be used for construction traffic.
- F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- G. Provide watering trucks, mulch, chemical stabilizers, or other control measures, complying with environmental protection requirements, to prevent airborne dust and silica from becoming a nuisance or health issue to Contractor personnel, neighboring properties, and the public.

1.11 WASTE REMOVAL

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
 - 1. Obtain and pay for any permits required for temporary signage by local authority having jurisdiction.

- B. Erect on site at location(s) established by Architect.
- C. Provide temporary directional signage as directed to facilitate site access for visitors and other construction personnel.
- D. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

- A. Field Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
 - 1. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
 - 2. Provide drinking water/water cooler and a private bathroom.
 - 3. Maintain the following materials in the field office, available to Architect and Owner's representative at all times:
 - a. A complete, up-to-date set of all Contract Documents, including FCs, RFIs, PCOs, and COs.
 - b. A complete, up-to-date set of all reviewed final shop drawings.
 - c. The most recent, up-to-date version of Contractor's Progress Schedule.
- B. Locate offices a minimum distance of 30 feet from other structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove temporary underground installations.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore in-place facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Rough Carpentry: 2x lumber, in length and depth required for floor to ceiling partitions. Partitions shall not be fastened to ceilings or flooring to remain. Provide additional bracing and concealed attachments to building structure.
- B. Gypsum Board: 1/2-inch gypsum wallboard; ASTM C 1396.
- C. Insulation: Mineral-wool fiber blankets; with maximum flame-spread and smoke-developed ratings of 25 and 50 when tested per ASTM E 84.
- D. Polyethylene Sheet: Minimum 10 mil reinforced sheeting; achieving a passing rating when tested per NFPA 701, and a maximum flame-spread rating of 15 when tested per ASTM E 84.
- E. Walk-Off Mats: Dust-, dirt- and silica-control walk-off mats at each entrance into the enclosed construction area and each entrance through temporary partitions.
- F. Hardware: Provide temporary hinges, latch, and lock at doors in temporary partitions. Where doors in temporary partitions are also indicated to serve as egress, provide ADA-compliant exit device and closer.

2.02 EQUIPMENT

- A. Fire Extinguishers: Provide portable UL rated extinguishers. Provide extinguisher types rated for potential classes of fire expected for construction work indicated.

PART 3 EXECUTION

3.01 STAIR USAGE

- A. Use of new stairs is permitted. To prevent wear on finishes, do not install finishes on stairs until construction foot traffic can be minimized. Clean and prepare stair substrate thoroughly prior to installation of finishes. Cover finishes after installation, and clean and restore to Owner's approval at Substantial Completion.
 - 1. Provide temporary stairs until new stairs are available.

3.02 PEST CONTROL

- A. Provide pest-control services at regular intervals, performed in compliance with regulations of state regulations, and by a pest-control firm licensed in the state where the project is located. Any chemicals and pesticides used shall be approved by EPA and local authority having jurisdiction. Contractor's pest control plan shall ensure the facility is free of termites, roaches, rodents, and other pests at time of Substantial Completion.
 - 1. Coordinate with Owner's Integrated Pest Management (IPM) plan where applicable.
 - 2. Provide Owner with a minimum 72 hours pre-notification for pest-control treatments.

3.03 TEMPORARY FIRE PROTECTION

- A. Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
 - 1. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations" for additional provisions and conditions that are not covered by Chapter 33 of the International Fire Code.
- B. Provide a fire-prevention program, review with all personnel on site, and post fire-prevention information in clearly visible area. Coordinate fire-prevention program with local fire department.
- C. Provide clearly labeled portable fire extinguishers.
- D. Provide fire watch in compliance with OSHA requirements during and after use of all potential ignition sources, including but not limited to, welders, grinders, cutting torches, heating and electrical equipment, and lighting.
- E. Do not allow smoking in areas under construction.

3.04 MOISTURE CONTROL

- A. Prevent the absorption of moisture and humidity by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Prior to building dry-in, store porous materials in a separate enclosed storage building. Keep all surfaces clear of standing water, and cover or otherwise protect all materials from water infiltration and damage. Do not enclose interior spaces until dry-in is complete and ventilation can remove excess moisture.
- C. After building dry-in, provide temporary mechanical ventilation for humidity and moisture control until the building HVAC system is operational. Do not store or install material in the building until ambient temperature and humidity is within manufacturer's acceptable range. Do not install wet materials, and ensure that substrates are fully dry prior to installing other materials over them.

- D. Provide continuous monitoring of installed materials. Remove gypsum board, wood products, and other mold-supporting products, if they become and remain wet for 48 hours. Remove and replace any materials showing visible signs of mold or mildew.

3.05 TEMPORARY FACILITY USAGE AND REMOVAL

- A. Maintenance and Usage: Keep temporary facilities clean and in well-maintained condition for the duration of the Project. Prevent misuse of or damage to facilities by construction personnel. Make repairs to temporary facilities or replace facilities as required to keep them in good operating condition and in compliance with applicable OSHA, local permitting, and other applicable regulations.
- B. Changeover: Coordinate changeover from temporary facilities to permanent facilities at Substantial Completion, unless an alternate arrangement for changeover has been agreed upon in writing by Owner.
 - 1. Contractor shall be responsible for repair, restoration, and cleaning of permanent facilities that are used for construction purposes after changeover.
- C. Removal: Unless otherwise indicated, temporary facilities and controls are the property of the Contractor, and shall be removed upon Architect's approval when Contractor can demonstrate that they are no longer needed.
 - 1. Comply with construction waste management and recycling requirements for temporary facilities and materials that are not able to be reused.
 - 2. After removal of temporary facilities and controls, complete all permanent construction that was not accessible due to the presence of temporary facilities.
 - 3. Remove materials that have become soiled or contaminated due to construction vehicle traffic, parking, temporary field offices, oil or other chemical spillage, and other temporary usage, and replace with clean material. Complete grading, landscaping, paving, and other site improvements, and repair or restore all damage to existing or previously completed site improvements.

END OF SECTION 015000

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Identification of Owner-supplied products.
- B. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- C. Section 014000 - Quality Requirements: Product quality monitoring.
- D. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.02 DEFINITIONS

- A. Comparable Product: An unnamed product that is similar in quality and performance to named product(s).
- B. Basis-of-Design Product: A specific product selected by the Architect for use in the design process; based on certain performance characteristics, physical qualities or details, a specialized finish type, pattern, or color, or other indicated characteristics.

1.03 WARRANTIES

- A. Product warranties shall be provided in addition to and run concurrently to Contractor's general warranty/guarantee.
 - 1. Unless otherwise indicated, all warranty terms shall start on the date of Substantial Completion.
- B. Manufacturer's Warranty: A standard warranty issued by the product manufacturer, covering production and material defects.
- C. Special Warranties: Warranties in addition to standard manufacturer's warranty, covering fabrication, installation, or specific performance items such as weathertightness
- D. Warranty Form: Warranty shall be provided on either manufacturer's standard form or on specified form. When a sample warranty form is not included in the Project Manual, the warranty shall be on mutually agreed form.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

- C. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

- A. Products Specified with a Single Named Product: Where required by Owner due to facility standards, provide the named product; no options or substitutions allowed.
- B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- E. Products Specified by Naming One or More Manufacturers with a Provision for Comparable Products: Unnamed comparable product may be submitted after award of Contract. Comply with requirements in "Comparable Products" article below.

2.04 BASIS-OF-DESIGN PRODUCTS

- A. Where a product is specified by naming a Basis-of-Design, comply with the following:
 - 1. Where a list of additional manufacturers is provided, provide the Basis-of-Design product or a comparable product by one of the listed manufacturers, in compliance with "Comparable Products" article below.
 - 2. Where a list of additional manufacturers is not provided, provide the Basis-of-Design product, or submit a substitution request in compliance with Section 012500 - Substitution Procedures.
 - 3. Basis-of-Design characteristics shall include requirements in the Specifications and on the Drawings.
 - 4. Where the Basis-of-Design lists a specific finish, manufacturers wishing to submit as a Comparable Product or as a substitution shall certify that they are able to provide an exact match to the specified finish, or that they will provide a custom finish to match.

2.05 COMPARABLE PRODUCTS

- A. Where a product is specified with a provision for comparable products, Contractors submitting a Comparable Product shall comply with the following:
 - 1. The submitted product shall not require changes to the Work, unless specifically approved by Architect. If changes are required, the Contractor shall resubmit the product as a substitution request, and the Contractor shall bear the cost of the changes, coordinate with other impacted contractors, and provide appropriate notations on record documents.
 - 2. Contractor shall provide, with the submittal, a detailed breakdown comparing the submitted product to at least one of the other listed products; list specified performance qualities, test results, dimensions, finish, and other critical properties.
 - 3. Contractor shall provide warranty data indicating that submitted Comparable Product complies with indicated warranty term(s).
- B. Comparable product submittals are subject to Architect's final approval. If a proposed product is found to be unacceptable, Contractor shall revert to one of the named products.

2.06 COLOR/FINISH OPTIONS

- A. Preselected Color/Finish: Where a specific manufacturer's premium or custom finish or color is indicated as the basis-of-design, other listed manufacturers shall certify that they can provide
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an exact match, or that they will provide pricing under the assumption that a custom finish or color will be required.

- B. Color/Finish Selection: Unless specifically indicated to either be a custom color or to be selected from manufacturer's standard range, color and finish selections shall be made from manufacturer's full range of options, including premiums, metallics, wood grains, etc.

2.07 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to location designated by Owner; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 012500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 011000 - Summary for identification of Owner-supplied products.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- C. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
 - B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
 - C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
 - D. Transport and handle products in accordance with manufacturer's instructions.
 - E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
 - F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
 - G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
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- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide off-site storage and protection when site does not permit on-site storage or protection.
- I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- J. Comply with manufacturer's warranty conditions, if any.
- K. Do not store products directly on the ground.
- L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 012000 - Price and Payment Procedures: Final application for payment.
- C. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- D. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
- E. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

1.02 SUBMITTALS

- A. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.03 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
- B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.04 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.
- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust and Silica Control: Execute work by methods to minimize raising dust and silica from construction operations. Provide positive means to prevent air-borne dust and silica from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust and silica that is generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

1. Minimize amount of bare soil exposed at one time.
 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.
- K. Hazardous Materials: Do not use materials or products that contain hazardous substances, for permanently installed products and materials, installation materials, or for cleaning or other construction use.

1.05 COORDINATION

- A. See Section 011000 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Fire Safety: Comply with provisions of 2018 International Fire Code, Chapter 33; "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
 - 1. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate.
 - 4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; prepare substrate per manufacturer's requirements for successful application of new finish.
 - 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. See Section 011000 for other limitations on outages and required notifications.
 - c. Provide temporary connections as required to maintain existing systems in service.
 3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - a. Use cutting methods such as sawing, drilling, and grinding that do not create impact stresses on existing construction. Do not use striking methods such as chopping or hammering.
 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
- J. Clean existing systems and equipment in all spaces impacted by alteration work.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.

3.06 CUTTING AND PATCHING

- A. Refer to Alterations article above for additional requirements related to cutting and patching of existing construction.
- B. Perform cutting and patching to:
1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.
-

- 8. Remove and replace defective and non-complying work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to specified condition.
- D. Employ skilled and experienced installer to perform cutting and patching.
- E. Restore work with new products in accordance with requirements of Contract Documents.
- F. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to maintain existing fire ratings, to full thickness of the penetrated element.
- H. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust and silica.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP AND ADJUSTING

- A. Coordinate with requirements of Section 019113 - General Commissioning Requirements.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Notify Architect and Owner seven days prior to start-up of each item.
- D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- F. Verify that wiring and support components for equipment are complete and tested.
- G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- I. Adjust operating products and equipment to ensure smooth and unhindered operation.
- J. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 017900 - Demonstration and Training.

3.11 FINAL CLEANING

- A. Execute final cleaning prior to Substantial Completion.
 - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Replace filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

- A. Prior to Substantial Completion, complete the following:
 - 1. Provide startup, testing, and adjusting of all systems and equipment.
 - a. Demonstrate that air and water systems are balanced and that automatic temperature control system is in control of all equipment. This may require separate

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- demonstrations if controls cannot be tested for applicable seasons of the year.
 - b. Submit written certification that testing/adjusting/balancing operations have been completed, and that systems are operation and under control in conformance with applicable specification section(s).
 - c. Submit written certification that all Building Commissioning has been completed.
 - d. Complete testing of the electronic security and detention systems and equipment, demonstrating security control.
2. Provide all inspections required by local authorities having jurisdiction to obtain Certificate of Occupancy, and provide written certification of completion of Special Inspections.
 3. Provide preventive maintenance services for all equipment used prior to Substantial Completion, and provide initial maintenance servicing for all products and equipment that will be subject to ongoing maintenance/service contracts.
 4. Provide final cleaning of all products, materials, and equipment, and provide touch up and restoration of exposed materials and finishes.
 5. Provide fresh batteries in all battery-powered products and equipment.
 6. Provide demonstration and training for Owner's personnel on all required systems and equipment.
 7. Coordinate a walkthrough with the Owner and the local fire department and other emergency services.
 8. To the maximum extent possible, remove temporary facilities and controls, construction equipment and tools, and similar items that are not part of the finished Work.
 9. Coordinate changeover with the Owner of permanent utilities, insurance requirements, and building's permanent keying and lock system.
- B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
 - C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
 - D. Conduct Substantial Completion inspection with representatives of Owner and Architect, and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
 1. At the Architect's sole discretion, based on the amount of outstanding work, the Architect may elect to decline to issue a Certificate of Substantial Completion and will provide a list of outstanding items that are required to obtain Substantial Completion. The Contractor shall request reinspection after the indicated items have been completed.
 - E. Upon approval, the Architect shall prepare and distribute Certificate of Substantial Completion, and will include a list of outstanding items and Final Correction Punch List.
 - F. The Owner will occupy the building after Substantial Completion, as specified in Section 011000.
 - G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
 - H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
 - I. Prior to final completion, complete the following:
 1. Ensure that the Certificate of Substantial Completion is fully executed by all required parties.
-

2. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.
3. Provide final pest and rodent control treatments and inspections.
4. Remove any remaining construction equipment, tools, and materials; perform additional cleaning required due to construction activities following Substantial Completion, and leave the site prepared for Owner occupancy.
5. Submit final demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
6. Submit final application for payment.

3.13 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
 1. Contractor's maintenance responsibility shall be through Substantial Completion, unless a longer term is required by individual specification section.
- B. Maintenance service shall not be assigned or transferred to any agent or third party without prior written consent of the Owner.

END OF SECTION 017000

**SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.
 - 1. Fire Safety: Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" and with NFPA 241 for provisions relating to accumulation and removal of combustible debris and waste.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.

- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.

- b. Amount, in tons or cubic yards.
- c. Include weight tickets as evidence of quantity.
- 7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to Contractor's site superintendent, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Coordinate with Division 2 demolition contractor to properly identify and separate recyclables. Store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Recycling of Existing Carpet: Remove carpet; cut sheet carpet to 4 foot widths, tightly roll, and pack in container. Palletize carpet tiles on 36 inch or smaller pallets; maximum 4 foot high. Tightly bind or shrink wrap packaged carpeting. Include carpet padding where applicable.
 - 1. Coordinate with Division 2 demolition contractor.

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2. Coordinate with Division 9 carpet installer to include waste and scrap from new carpet work as applicable.
 3. Refer to Carpet America Recovery Effort (CARE) guidelines and ship or deliver carpet to a designated reclamation/recycling facility.
- I. Recycling of Existing Acoustical Ceiling Panels: Verify with ACP manufacturer that existing ceiling tiles can be recycled. Following verification, remove and stack ceiling tiles on pallets and wrap or band the pallet loads for pick up or delivery per recycler guidelines.
1. Coordinate with Division 2 demolition contractor.
 2. Coordinate with Division 9 ACP manufacturer's recycling program; contact recycler when there is a full trailer load or approx. 30,000 square feet of removed ceiling. Coordinate with recycler to arrange pick up from the project site and transport to recycling facility at no cost.
 3. If quantity to be recycled is less than 30,000 square feet, coordinate with ACP manufacturer for delivery to a consolidation point/facility at Contractor's cost.
- J. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- K. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 017419

**SECTION 017800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittal procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect within 15 days after the date of Substantial Completion.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within 15 days after acceptance.
 - 2. Submit one PDF draft copy of completed documents within 15 days after the Closeout Conference. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. After revisions are complete, submit one bound hard copy and PDF electronic file of revised final documents in final form within 15 days after Substantial Completion.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 15 days after acceptance.
 - 2. Make other submittals within 15 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 15 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
 - 4. Miscellaneous record submittals.
 - B. Ensure entries are complete and accurate, enabling future reference by Owner.
-

1. Include revised Drawings reissued during Bidding and Construction.
- C. Store record documents separate from documents used for construction.
 1. Keep record documents in a location accessible to Architect for periodic review and reference.
 2. Maintain in legible condition. If record document set becomes damaged or excessively dirty, transfer comments to clean set prior to submittal to Architect.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
- F. Miscellaneous Record Submittals: Where other specification sections require completion certifications, or closeout or record submittals, submit in a single binder organized by specification section.

3.02 ASSEMBLY OF RECORD DOCUMENTS

- A. Submittal for Architect's Review:
 1. Submit PDF scanned copy of marked up prints.
 2. Architect shall review and provide comment on completeness
- B. Submittal for Distribution to Owner:
 1. After Architect has approved for content and completeness, submit PDF scanned copy of final marked up prints, and submit hard copy originals.
 2. Submit full set of Drawings, regardless of whether any modification or markings are on each sheet.

3.03 OPERATION AND MAINTENANCE DATA

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide

recommendations for inspections, maintenance, and repair.

- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
 - B. For systems required to be commissioned, in accordance with North Carolina Building Energy Code, O& M manuals for systems and equipment included within the systems to be commissioned include:
 - 1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
 - 2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance. except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
 - 3. Name and address of at least one service agency.
 - 4. HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions.
 - 5. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
 - 6. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified.
 - 7. A schedule for inspecting and recalibrating all lighting controls.
 - 8. A narrative of how each system is intended to operate, including recommended set points.
 - C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
 - D. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
 - E. Include color coded wiring diagrams as installed.
 - F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - G. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - H. Provide servicing and lubrication schedule, and list of lubricants required.
 - I. Include manufacturer's printed operation and maintenance instructions.
 - J. Include sequence of operation by controls manufacturer.
-

- K. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- L. Provide control diagrams by controls manufacturer as installed.
- M. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- N. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- O. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- P. Include test and balancing reports.
- Q. Additional Requirements: As specified in individual product specification sections.

3.06 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder on front and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.

3.07 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 15 days after completion of the applicable item of work. Except for

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items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Retain warranties and bonds until time specified for submittal.
- D. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- E. Cover: Identify each binder on front and spine with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- G. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- H. Provide photocopy of each warranty in operation and maintenance manuals; locate each warranty with applicable O&M data for product or equipment.

END OF SECTION 017800

**SECTION 017900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products, systems, equipment, and other items where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance of products, systems, equipment, and as otherwise indicated in specific specification sections.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit not less than four weeks prior to start of training.
 - 2. Revise and resubmit until acceptable.
 - 3. Provide an overall schedule showing all training sessions.
 - 4. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 - 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 - 1. Format: DVD Disc.
 - 2. Label each disc and container with session identification and date.
 - 3. Where available, provide manufacturer's pre-produced training videos in conjunction with live demonstration and training video.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Instructor shall be certified by the manufacturer or fabricator of system.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable, and if acceptable to Owner.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Complete demonstrations within two weeks after the date of Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Complete demonstrations within two weeks after the date of Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site, utilizing installed products and equipment, unless otherwise indicated.
- B. Provide training in minimum two hour segments.
- C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 2. Typical uses of the O&M manuals.
- E. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.

4. Discuss cleaning products and procedures, including recommended cleaning products and products that are detrimental to equipment operation or finishes.
 5. Provide hands-on training on all operational modes possible and preventive maintenance.
 6. Emphasize safe and proper operating requirements; discuss relevant health and safety issues, warning or error indications, and emergency procedures and shutdown.
 7. Discuss common troubleshooting problems and solutions. Include minor adjustments for resolving noise, vibration, and improving system efficiency.
 8. Discuss any peculiarities of equipment installation or operation.
 9. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage. Include discussion of continuing maintenance agreements and procedures.
 10. Review recommended tools and spare parts inventory suggestions of manufacturers.
 11. Review spare parts and tools required to be furnished by Contractor.
 12. Review spare parts suppliers and sources and procurement procedures.
- F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 017900

**SECTION 018119
INDOOR AIR QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY

- A. Provide Indoor Air Quality (IAQ) Management Plan to remain in force during the construction period.
- B. Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition 2007, available from SMACNA (703-803-2980 or www.smacna.org).

1.02 SUBMITTAL

- A. Construction Indoor Air Quality Management Plan (CIAQM Plan).

PART 2 OBJECTIVES DURING CONSTRUCTION

2.01 PROTECTION

- A. Store all materials and equipment in a protected area (inside warehouse or storage trailer). Protect materials and equipment that are too large or heavy to store in a trailer from water and dirt/dust/debris.
 - 1. OPTION: When stored outside, provide two layers of minimum 8-mil poly on the ground and elevate equipment or material a minimum of 4 inches to allow water to run off. Secure top and sides with two layers of 8-mil poly to prevent water penetration and dust/dirt accumulation.
- B. Protect HVAC equipment from dust and odors. Do not store equipment in areas near painting, pressure washing, or excavation. Do not operate equipment during cutting or grinding of masonry or concrete.
 - 1. Refer to Division 23 for construction filter requirements for protection of mechanical duct systems during construction.
 - 2. Clean ductwork when installed. Cap ends with poly during construction to prevent contamination.
 - 3. Do not operate HVAC system until the exterior walls, roof, glass, doors and building filters are properly installed.
 - 4. If air handlers must be used during construction, provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each air-handling unit. Provide specified prefilters and final filters for operation during construction or install temporary 4-inch MERV 8 filters at each return air grille for operation during construction.
 - 5. Replace all filtration media immediately prior to Substantial Completion.
 - a. Filtration media installed in air-handling units shall have a Minimum Efficiency Reporting Value (MERV) of 8.
 - 6. Do not perform Testing and Balancing until dust or odor generating activities are completed.

2.02 SOURCE CONTROL

- A. Minimize IAQ contaminants introduced by construction materials.
- B. Store waste construction materials a minimum of 30 feet away from the building.
- C. Do not smoke within 30 feet of the exterior building perimeter.

2.03 PATHWAY INTERRUPTION

- A. Provide barriers to contain construction areas to allow a portion of the building to be cleaned and then operate the HVAC system in that cleaned area. Acceptable barriers include dust curtains and temporary walls.
 - 1. Protect areas of the building in which HVAC is operational by physical barriers from areas of the building not acceptable for operation of the HVAC system.
- B. Maintain areas within 30 feet of outdoor air intakes free of dust, dirt, debris, and volatile materials while the HVAC system is in operation.

2.04 HOUSEKEEPING

- A. As dust accumulates at the Site, it can become airborne when disturbed by nearby activity. Similarly, spills or excess applications of products containing solvents will increase odors at the Site. Leaving the Site wet or damp for more than a day could result in the growth of mold and bacteria. Therefore, Site cleanup and maintenance is important to maintaining good IAQ during construction.
- B. Perform the following to control contaminants at the Site:
 - 1. Suppress dust with wetting agents or sweeping compounds.
 - 2. Provide an efficient dust collection method (e.g. a damp rag, wet mop, or vacuum equipped with a high efficiency particulate arrester (HEPA) filter or wet scrubber).
 - 3. Remove spills or excess applications of solvent-containing products immediately. Provide low-VOC emitting spot removers and cleaning agents near occupied areas.
 - 4. Remove accumulated water and keep work areas as dry as possible, including the use of dehumidification, if necessary.
 - 5. Once building is enclosed, vacuum with HEPA filtered vacuum cleaners to prevent settled dust from becoming airborne again.
 - 6. Protect porous materials from exposure to moisture. Replace items that remain damp for more than four hours.

END OF SECTION 018119

SECTION 018317
EXTERIOR BUILDING ENCLOSURE AIR BARRIER REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes administrative and procedural requirements for accomplishing an airtight building enclosure that controls infiltration or exfiltration of air, including but may not be limited to:
1. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the exterior building enclosure shall be "the air barrier system."
 2. Coordinate between trades, schedule and sequence the Work, and provide preconstruction meetings, inspections, tests, and related actions.
 3. Reports performed by Contractor, independent agencies, and governing authorities.
 4. Construct the building enclosure with a continuous air barrier system to control air leakage into (infiltration) and out of (exfiltration) conditioned spaces. The air barrier system shall have the following characteristics:
 - a. Continuous, with all joints sealed.
 - b. Structurally supported to withstand positive and negative air pressures applied to the building enclosure.
 - c. Connections between:
 - 1) Foundation and walls.
 - 2) Walls and windows and doors.
 - 3) Different wall systems.
 - 4) Wall and roof.
 - 5) Walls, floors, and roofs across construction joints, control joints and expansion joints.
 - 6) Walls, floors and roofs to utility, pipe and duct penetrations.
 5. Make all penetrations of the air barrier membrane or system and paths of air infiltration / exfiltration air-tight.

1.02 RESPONSIBILITIES

- A. Contractor responsibilities:
1. Coordinate affected trades and sequence construction to ensure continuity of the air barrier system, joints, junctures, and transitions between materials and assemblies of materials and products, from substructure to walls to roof.
 - a. Coordinate the sequence of activities to accommodate required services with a minimum of delay.
 - b. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 2. Provide quality assurance procedures, testing and verification as required.
 - a. Schedule times for inspections, tests, taking samples, and similar activities.
 3. Facilitate inspections, tests, and other quality-control services required.
 - a. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested.
 - b. Notify the agency sufficiently in advance of operations to permit assignment of personnel.
-

- c. Services include, but are not limited to, the following:
 - 1) Provide access to the Work.
 - 2) Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 - 3) Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - 4) Deliver samples to testing laboratories.
 - 5) Provide security and protection of samples and test equipment at the Project Site.
- 4. Organize pre-installation conference and preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.
- 5. Provide mockup of exterior wall assembly as required.
- 6. Coordinate the Work and trades to provide an airtight building enclosure.
 - a. Continuity of the air barrier materials and products with joints to provide assemblies.
 - b. Continuity of all exterior enclosure assemblies with joints and transition materials to provide an exterior enclosure air barrier system.
 - c. Specific quality-control requirements for individual construction activities are also indicated in other applicable sections of the specifications. Ensure each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each such section.
 - d. Inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - e. Requirements to provide an airtight exterior building enclosure is not limited by quality-control services performed by Architect, Owner, or authorities having jurisdiction and are not limited by provisions of this section.

1.03 PERFORMANCE REQUIREMENTS

- A. Materials: Used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178.
- B. Assemblies of materials and components: Shall have an air permeance not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2357.

1.04 SUBMITTALS

- A. Submit a written report of each inspection, test, or similar service performed by the air barrier manufacturer's technical representative, to the Owner, Architect, and Contractor.
 - 1. Report Data: Written reports of each inspection, test, or similar service shall include, but may not be limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.

- h. Complete inspection or test data.
- i. Test results and an interpretation of test results.
- j. Ambient conditions at the time of sample taking and testing.
- k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
- l. Name and signature of laboratory inspector.
- m. Recommendations on retesting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protect the Work, regardless of the assignment of responsibility for inspection, testing, or similar services.

AIR BARRIER SYSTEM PRE-INSTALLATION CONFERENCE GUIDE

PURPOSE:

Few building construction components require the coordinated activities of more different trades on the construction, design, and management teams than an air barrier system. Once an air barrier has been covered, any remedies for problems with the components or installation can be costly and time-consuming.

Contractor and subcontractors must have a working knowledge of the air barrier installation, proper sequencing, and must work toward a common goal. Through the use of the integrated mockup panel and this Pre-Installation Conference Guide, gaining such knowledge should be enhanced.

Source: Much of this checklist utilizes content from Tremco's "Air Barrier Project Management – Pre-Construction Meeting Checklist" document.

Contractor may request an electronic version of this document for editing purposes and for your use.

Send a copy of this guide to the affected trades and/or attendees so they can attend the Conference prepared to discuss these topics and to fill in as much of this information as possible prior to the meeting, or be prepared to fill them in at the meeting.

CHECKLIST:

Submit and/or complete the following prior to conducting the Pre-Installation Conference. Confirm any additional submittal requirements with the relevant specification sections. Check those items below that you have completed or received "Approved" submittals from the Architect. Delete those that do not apply.

- | | | |
|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------|
| <input type="checkbox"/> Product data | <input type="checkbox"/> Shop drawings | <input type="checkbox"/> Product Certificates |
| <input type="checkbox"/> Product test reports | <input type="checkbox"/> Installer qualifications | <input type="checkbox"/> Samples |
| <input type="checkbox"/> Compatibility docs | <input type="checkbox"/> Integrated mockup | <input type="checkbox"/> Quality Assurance Program |
| <input type="checkbox"/> ABAA certifications | <input type="checkbox"/> Warranty sample | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Air Barrier System Subcontractor reviewed submittals of other indicated/specified trade(s) | | |

MANDATORY ATTENDEES:

Attendance by the following parties and affected trades is mandatory. Identify and ensure any other trades or parties involved or affected by the installation of the air barrier system components are also present. Check those below who actually attend the meeting. Delete those that do not apply.

- | | |
|------------------------------------------------------------------------------|------------------------------------------------------|
| <input type="checkbox"/> Owner and/or Owner's representative | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Owner's Testing Agency (if hired to inspect ABS) | <input type="checkbox"/> Contractor |
| <input type="checkbox"/> Air barrier installer / subcontractor | <input type="checkbox"/> Masonry subcontractor |
| <input type="checkbox"/> Air barrier manufacturer's technical representative | <input type="checkbox"/> Roofing subcontractor |
| <input type="checkbox"/> Window opening subcontractor | <input type="checkbox"/> Sheathing subcontractor |
| <input type="checkbox"/> Exterior Insulation subcontractor | <input type="checkbox"/> Concrete subcontractor |
| <input type="checkbox"/> Exterior Metal Panel subcontractor | <input type="checkbox"/> CFSF-S subcontractor |
| <input type="checkbox"/> Steel frame (hollow metal) subcontractor | <input type="checkbox"/> Waterproofing subcontractor |
| _____ | _____ |

REVIEW OF RELEVANT PROJECT CONTRACT SPECIFICATION SECTIONS:

Review the Contract Specifications and identify and note any modifications that may be necessary, so all parties understand what is required of them. Submit any modifications via appropriate supplemental documents (FC or PCO). Edit specification sections below to match those of this Project.

SPEC SECTION	MODIFICATIONS (IF ANY)
018317	

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REVIEW OF RELEVANT PROJECT SHOP / SUBMITTAL DRAWINGS:

Review the submittals and identify and note any modifications that may be necessary, so all parties understand what is required of them. Resubmit those submittals that have not been approved by the Architect.

PROJECT SUBMITTAL / SHOP DRAWING REFERENCE	MODIFICATIONS (IF ANY)

REVIEW OF PRODUCTS:

Review the type of air barrier system that will be provided on the Project and identify each component. Delete those that do not apply.

COMPONENT	ACTUAL PRODUCT TO BE PROVIDED FOR PROJECT
SPF INSULATION – FIELD OF WALL	
SPF INSULATION (WALL) – VOIDS / CRACKS / SHIMS	
SPF INSULATION – FIELD OF ROOF	
FLUID-APPLIED MEMBRANE – PERMEABLE - WALL	
FLUID-APPLIED MEMBRANE – IMPERMEABLE -WALL	
SELF-ADHERED MEMBRANE – PERMEABLE - WALL	
SELF-ADHERED MEMBRANE – IMPERMEABLE -WALL	
SELF-ADHERED MEMBRANE – PERMEABLE - ROOF	
SELF-ADHERED MEMBRANE – IMPERMEABLE -ROOF	
TRANSITION MEMBRANE – SELF-ADHERED	
PRIMER	
MASTIC / TERMINATION SEALANT	

CONSTRUCTION TIE-IN RESPONSIBILITY:

Air barrier systems are successful when a full building envelope/enclosure – without penetrations, voids, holes, gaps, and cracks – is complete. This is critical when numerous trades are involved in the tying-in of the air barrier system to all facets of the exterior building envelope. Utilize the table below to ensure everyone knows who is responsible for the indicated tie-in.

TIE-IN AREA	SUBCONTRACTOR RESPONSIBLE FOR TIE-IN
EXTERIOR FOOTING TO EXTERIOR FOUNDATION WALL	
EXTERIOR FOUNDATION TO EXTERIOR WALL	
SLAB-ON-GRADE TO WALL (EXTERIOR AND INTERIOR)	
SLAB-ON-GRADE JOINTS	
SLAB-ON-GRADE PENETRATIONS	
EXTERIOR WALL TO STEEL FRAME/HOLLOW METAL (E.G., DOORS AND WINDOWS)	
EXTERIOR WALLS TO ALUMINUM FRAMES (E.G., WINDOWS AND LOUVERS)	
DIFFERENT EXTERIOR WALL SYSTEMS (E.G., MASONRY TO METAL)	
EXTERIOR HEAD-OF-WALL TO SLOPING ROOF	
PARAPET WALLS TO ROOF	
EXTERIOR WALL JOINTS	
EXTERIOR SHELF ANGLES	
EXTERIOR STEEL LINTELS	
EXTERIOR WALL PENETRATIONS (E.G., PIPES, DUCTS)	
ROOF PENETRATIONS	
ROOF PERIMETER	

COMPATIBILITY REVIEW:

Each trade/installer shall identify materials that may have potential compatibility issues. For example, some membranes may be subject to decomposing when placed in contact with other materials or components, especially sealants and primers; or may deteriorate if left exposed to the elements and are not protected. Delete those trades/installers that do not apply to this Project.

TRADE / INSTALLER	ISSUES / RESOLUTIONS
AIR BARRIER	
WINDOW	
STEEL FRAME (HOLLOW METAL)	
CFSF-S	
EXTERIOR METAL PANELS	
WATERPROOFING	
MASONRY	
ROOFING	
SHEATHING	
CONCRETE	
INSULATION	
FLEXIBLE FLASHING	
METAL FLASHING	
STRUCTURAL STEEL	

SUBSTRATE PRIMER CONSIDERATIONS:

Indicate whether the substrate for the air barrier material requires the use of a primer, and if so, identify the actual product to be used on the Project. Delete those that do not apply.

SUBSTRATE	YES	NO	PRODUCT
CMU			
SHEATHING			
CONCRETE			
PRECAST			
METAL PANELS			
ROOF SUBSTRATE BOARD			
FLEXIBLE FLASHING			
METAL FLASHING			
WATERPROOFING			
STEEL FRAME / HOLLOW METAL			
STRUCTURAL STEEL			

SUBSTRATE PREPARATION CONSIDERATIONS:

Indicate whether the substrate for the air barrier material requires special treatment or preparation (e.g., flush joints in CMU), and if so, identify the method to be used on the Project. Delete those that do not apply.

SUBSTRATE	YES	NO	METHOD / PROCEDURE	SUBCONTRACTOR RESPONSIBLE
CMU				
SHEATHING				
CONCRETE				
PRECAST				
METAL PANELS				
ROOF SUBSTRATE BOARD				
WINDOW FRAMES				
FLEXIBLE FLASHING				
METAL FLASHING				
WATERPROOFING				
STEEL FRAME / HOLLOW METAL				
STRUCTURAL STEEL				

JOINT CONSIDERATIONS:

It is critical for all joints, gaps, voids, cracks, seams, etc. to be sealed/closed for the air barrier to function properly (based on air barrier manufacturer's instructions). If applicable, indicate the method to be used to close the joints and who is responsible. Delete those that do not apply.

TYPE OF JOINT	METHOD USED TO CLOSE JOINT	SUBCONTRACTOR RESPONSIBLE
CMU		
SHEATHING		
CONCRETE		
PRECAST		
METAL PANELS		
ROOF SUBSTRATE BOARD		
WINDOW FRAMES		
STEEL (HOLLOW METAL) FRAMES		
HEAD-OF-WALL		
OMITTED CMU BLOCK		

INSTALLATION TEMPERATURES:

A major factor in contributing to a successful air barrier system installation is to monitor and install the components within the proper temperature ranges and weather conditions. Indicate below the proper temperature range for each component; the procedure for maintaining the proper temperature range; and the party responsible for maintaining the proper temperature range in accordance with the requirements. Delete those that do not apply.

COMPONENT	PROPER TEMPERATURE RANGE	PROCEDURE AND SUBCONTRACTOR RESPONSIBLE
SPF INSULATION – FIELD OF WALL		
SPF INSULATION (WALL) – VOIDS / CRACKS / SHIMS		
SPF INSULATION – FIELD OF ROOF		
FLUID-APPLIED MEMBRANE – PERMEABLE - WALL		
FLUID-APPLIED MEMBRANE – IMPERMEABLE -WALL		
SELF-ADHERED MEMBRANE – PERMEABLE - WALL		
SELF-ADHERED MEMBRANE – IMPERMEABLE -WALL		
SELF-ADHERED MEMBRANE – PERMEABLE - ROOF		
SELF-ADHERED MEMBRANE – IMPERMEABLE -ROOF		
TRANSITION MEMBRANE – SELF-ADHERED		
PRIMER		
MASTIC / TERMINATION SEALANT		

AIR BARRIER PROTECTION:

The air barrier system shall be protected during construction. Indicate below how the components will be protected (method used), by whom, and when. Delete those that do not apply.

COMPONENT	METHOD USED FOR PROTECTION	SUBCONTRACTOR	WHEN
SPF INSULATION – FIELD OF WALL			
SPF INSULATION (WALL) – VOIDS / CRACKS / SHIMS			
SPF INSULATION – FIELD OF ROOF			
FLUID-APPLIED MEMBRANE – PERMEABLE - WALL			
FLUID-APPLIED MEMBRANE – IMPERMEABLE -WALL			
SELF-ADHERED MEMBRANE – PERMEABLE - WALL			
SELF-ADHERED MEMBRANE – IMPERMEABLE -WALL			
SELF-ADHERED MEMBRANE – PERMEABLE - ROOF			
SELF-ADHERED MEMBRANE – IMPERMEABLE -ROOF			
TRANSITION MEMBRANE – SELF-ADHERED			
PRIMER			
MASTIC / TERMINATION SEALANT			

AIR BARRIER REPAIR:

Discuss how any damage, including but not limited to, accidental holes in the air barrier system, will be repaired – and by whom. Indicate the actual product to be used to perform any repairs in the air barrier components. Delete those that do not apply.

COMPONENT	PRODUCT TO BE USED FOR REPAIR	SUBCONTRACTOR RESPONSIBLE
SPF INSULATION – FIELD OF WALL		
SPF INSULATION (WALL) – VOIDS / CRACKS / SHIMS		
SPF INSULATION – FIELD OF ROOF		
FLUID-APPLIED MEMBRANE – PERMEABLE - WALL		
FLUID-APPLIED MEMBRANE – IMPERMEABLE -WALL		
SELF-ADHERED MEMBRANE – PERMEABLE - WALL		
SELF-ADHERED MEMBRANE – IMPERMEABLE -WALL		
SELF-ADHERED MEMBRANE – PERMEABLE - ROOF		
SELF-ADHERED MEMBRANE – IMPERMEABLE -ROOF		
TRANSITION MEMBRANE – SELF-ADHERED		
PRIMER		
MASTIC / TERMINATION SEALANT		

INSULATION SECURED TO OR OVER AIR BARRIER MATERIAL:

Address any concerns or issues of installing insulation over the air barrier material (foundation, walls, and roof), such as preparation, securing, or fastening methods. Delete those that do not apply.

INSULATION TYPE	METHOD FOR SECUREMENT	CONCERNS (IF ANY)
SPF		
XPS		
POLYISO		
EPS		
EPX		

CFSF-S LOCATIONS: DELETE IF THEY DO NOT APPLY.

Where CFSF-S is a component in the exterior wall assembly, the air barrier installer may need to mark the material itself to indicate where the framing is located. The insulation subcontractor, in turn (when the insulation is not the air barrier), may need to transfer those marks onto the insulation. If any of the above is required, discuss and identify below. Delete those that do not apply.

COMPONENT	SUBCONTRACTOR RESPONSIBLE FOR LOCATION MARKS, IF NECESSARY
SHEATHING	
AIR BARRIER	
INSULATION	

OTHER CONSIDERATIONS OR COMMENTS:

END OF AIR BARRIER SYSTEM PRE-INSTALLATION CONFERENCE GUIDE

END OF SECTION 018317

SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 220800 – Commissioning of Plumbing Systems
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 250800 – Commissioning of Integrated Automation Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. An independent third party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of the construction phase commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design intent. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance.
- C. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing Contractors to provide a finished product.
- D. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team, cooperating and coordinating all commissioning activities with the Owner, Design Professionals, General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

1.3 DEFINITIONS

- A. Commissioning Agent (CxA): The Commissioning Agent is a third party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).
- B. Commissioning Team: The Commissioning Team is a group of individuals selected by each company to represent that company for direct involvement in the commissioning activities during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to; Commissioning Agent, Owner, Architect, System Design Engineer, General Contractor, and all Sub-Contracting Companies.
- C. Design Professional(s) (Designers): The Design Professional(s) are the designers and design firm representatives for the architectural, fire protection, mechanical, electrical, plumbing, fire alarm, telecommunications security and other systems outside of the scope of the project. Typically, the Design Professional(s) do not include structural and civil design representatives unless structural or civil systems are specifically included within or are associated with the systems being commissioned.
- D. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Contracting parties outside of the scope of the systems being commissioned are not included.
- E. Subcontractors: The term Subcontractors utilized herein refers to the any and all subcontracting companies or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section [1.5 - Systems Included in Commissioning](#). Subcontracting parties outside of the scope of the systems being commissioned are not included.
- F. Pre-Functional Checklist (PFC): The PFC's are a series of checklists developed by the Contractors intended to verify the full and complete installation and start-up of each system component of the Systems Included in Commissioning. Checklists shall be based upon submitted documentation and updates to the Construction Documents. Checklists include both static and dynamic checks which may overlap with equipment start-up. Checklists also include verification of the installed equipment matching the submittals and the construction documents.

- G. Functional Performance Tests (FPT): The FPT's are a series of system tests developed by the Commissioning Agent intended to verify the full functionality and operability of each of the Systems Included in Commissioning. FPT's include load testing, controls verification, sequencing, TAB verification, system integration, etc. FPT's are generated by the CxA, reviewed by the Cx Team, conducted by the responsible contractors and witnessed by the CxA.
- H. Pre-Verification Tests (PVT): The PVT's are exact copies of the Functional Performance Tests. This set of tests are specifically for the installing and testing contractors to perform all of their pre-testing activities. The difference between the FPT's and the PVT's is that the FPT's are witnessed by the CxA for final acceptance while the PVT's are not required to be witnessed. It is recommended that the General Contractor witness the PVT's to ensure system readiness.

1.4 ROLES AND RESPONSIBILITIES

A. Commissioning Agent

1. The commissioning roles and responsibilities of the CxA are outlined within the Commissioning Plan. The CxA is not contractually obligated to complete any tasks defined within the Commissioning Specifications because they are independently contracted through the Owner.
2. The Commissioning Agent shall NOT have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).
3. Prepare the Commissioning Plan. Update the Commissioning Plan after the Commissioning Kick-Off meeting. Include list of all contractors for commissioning events by name, firm and trade specialty. The Commissioning Plan is a living document which may be continuously updated throughout the project.
4. Assist the contractors in scheduling the Commissioning Kick-Off Meeting. The CxA will host the Kick-Off Meeting at some convenient location and time suitable to the Owner, Designers, Contractors and Sub-Contractors. This meeting will review the Cx Plan and every aspect of the Commissioning Process specific to this project.
5. Assist the contractors in integration of Commissioning Activities into the overall Construction Schedule.
6. Review all documentation regarding changes to the Contract Documents or Clarifications. These include Meeting Minutes, Addendums, RFI's, Change Orders, ASI's, etc. for their effect on Commissioning.
7. The Commissioning Agent shall receive a copy of all submittals pertaining to the systems being commissioned from the Contractor(s).
8. The Commissioning Agent shall conduct Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning

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Activities increase. Meetings may be held as often as monthly until systems are prepared for verification testing.

9. The Commissioning Agent shall conduct periodic inspections of work in progress and shall generate and distribute a report for each inspection. All issues and discrepancies found during these inspections shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
 10. The CxA will provide Functional Performance Test procedures for the testing of the Systems being Commissioned. These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent and meets both the Basis of Design (BOD) and the Owner's Project Requirements (OPR.)
 11. Included within the Functional Performance Tests are checks to verify the TAB Report. After both a review of the Final TAB Report and field verification of the TAB Report accuracy, the CxA will recommend acceptance of the Final Test, Adjustment and Balance Report.
 12. The CxA will review Pre-Functional Checklists developed, filled-out and completed by the Contractors for the purposes of verifying proper installation. Checklists are to be filled-out by the Contractors and the CxA will verify their completion, including reviewing installations in the field to confirm checklist accuracy.
 13. The CxA will witness Functional Performance Testing which shall be performed by the installing contractors. All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent.
 14. Assist with training by reviewing and approving of the Contractor(s) Training Plan and individual Training Agendas. The Commissioning Agent shall review the Operations and Maintenance Manuals, As-Builts and the Systems Manual for completeness and accuracy.
 15. Prepare the Final Commissioning Summary. Recommend acceptance of the Final Product, by the Owner, based upon the results of Commissioning.
- B. Design Professional(s)
1. The commissioning roles and responsibilities of the System Design Professional(s) are outlined within the Commissioning Plan. The System Design Professional(s) is not contractually obligated to complete the tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are required for the successful completion of Commissioning.
 2. The commissioning roles and responsibilities outlined within the Commissioning Plan do not supersede any contractual requirements between the Owner and the Systems Design Professional(s), nor do they relieve the Systems Design Professional(s) of any Designer or Construction Administrator responsibilities.

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3. The System Design Professional(s) will provide Construction Documentation including all Bid-Set Drawings and Specifications, Addendum, Change Orders, Architectural Supplemental Instructions, and Requests for Information to the Commissioning Agent. Additionally, the System Design Professional(s) shall distribute to the Commissioning Agent a copy of all meeting minutes and site inspection reports for review. The Contractor, Architect and System Design Professional presented Value Engineering Proposals shall be submitted to the Commissioning Agent. It is the responsibility of the System Design Professional(s) and/or Architect to inform the Commissioning Agent of the Value Engineering Proposals which are accepted.
4. Conduct periodic inspections of work in progress as outlined within the contractual requirements between the Owner and the Systems Design Professional(s). Systems installation verification is not the responsibility of the Commissioning Agent. Rather, commissioning is implemented as a tool to assist the Systems Design Professional(s) with installation verification such that there is an overall increase in quality control.
5. The System Design Professional(s) retains responsibility for the overall system evaluation, adequacy of the system to meet design intent, capacity of the system, and other elements of the system design. The Commissioning Agent is not responsible for overall system functionality. Comments or issues found by the Commissioning Agent must be evaluated by the System Design Professional(s) prior to corrective actions.
6. The System Design Professional(s) will review the Functional Performance Test Procedures provided by the Commissioning Agent. The System Design Professional(s) shall confirm that the test procedures follow the Sequence of Events and properly test the over functionality of the system as it was intended to operate.

C. General Contractor

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Include commissioning requirements in the individual subcontracts for all disciplines relating to the systems to be commissioned as outlined within Specification 019113 Section [1.5 - Systems Included in Commissioning](#). Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.
3. Schedule - Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section [2.1 – Project Schedule](#). Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.
4. Submittals - Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section [2.3 – Submittals](#).
5. Cx Representative - Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents. Provide one or two representatives to specifically participate in Commissioning Activities and generally oversee the Commissioning Process. Retain

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these individuals for the duration of the project to ensure full comprehension and understanding of the scope of commissioning. The Primary Commissioning Representative for the Prime Contractor shall not be changed or replaced for the duration of the project.

6. Cx Meetings - Primary Representative shall attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
7. Cx Activities - Coordinate all scheduled commissioning activities with the Commissioning Agent. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: Mock-Up Inspections, In-Wall Inspections, Above Ceiling Inspections, System Start-up, Equipment Start-up, Duct Pressure Tests, Pipe Pressure Tests, Electrical Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.
8. Issues Log - Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics, Functional Performance Test results or any other commissioning activity.
9. Quality Control Tests - Upload all Quality Control Reports to Facility Grid. Utilize the organizational method provided by the Commissioning Agent for organizing the Quality Control Reports and upload them accordingly. Report files shall be PDF and shall be appropriately labeled to clearly identify contents. Follow Specification 019113 Section 3.7 – Quality Control and Start-Up Reporting.
10. Pre-Functional Checklists – Develop PFCs for each individual component of each of the Systems to be Commissioned. Individual contractors or sub-contractors responsible for the acquisition, installation, start-up and testing of each system and components thereof, are responsible for the completion of the PFCs. The General Contractor is responsible for verifying completion of the PFC's by each contractor assigned responsibility. Regularly report PFC completion status to the Commissioning Agent. Ultimately, the General Contractor must verify all PFC's have been fully and accurately completed and check the final box that indicates such.
11. System and Equipment Start-Up - Schedule, manage and coordinate equipment and systems energization and start-up activities. The General Contractor is responsible for coordinating each sub-contractor and their vendor to submit all start-up materials for approval, distribute energization plan, schedule associated start-up activities and collect subcontractor record documentation of start-up. System and Equipment Start-Up to be managed according to Specification 019113 Section 3.5 – System and Equipment Start-Up.
12. Pre-Verification Tests - Distribute responsibility of PVT completion to the installing contractors. Verify completion of the PVT's by each contractor assigned responsibility.

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Regularly report PVT completion status to the Commissioning Agent. Ultimately, the General Contractor must verify all PVT's have been fully and successfully executed.

13. Functional Performance Tests - Schedule, manage and coordinate the execution of the FPT's by the installing contractors with the Cx Team. The General Contractor shall be responsible for testing each FPT with the necessary contractors to execute the tests, provide the necessary test equipment and with the Cx Team such that the CxA and any other team members are present to witness the tests. Remedy all contractual deficiencies for non-conformance with contract documents identified through Functional Performance Testing and other verification tests.
14. Training - Schedule, manage and coordinate the execution of all Training Activities. The General Contractor is responsible for coordinating each sub-contractor and their vendor to submit all training materials for approval, schedule associated training and document execution and attendance. Training to be managed according to Specification 019113 Section [3.14 – Systems and Equipment Training](#).

D. Subcontractors

1. Subcontractor responsibilities are mostly outlined herein. Additional Subcontractor responsibilities are found in their individual associated Commissioning Specification for their Division. See specification 019113 Section 1.1 – Related Documents for the list of respective disciplines in addition to the requirements outlined herein.
2. Include commissioning requirements within the individual subcontract for systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.
3. Schedule - Provide activities and durations for incorporation into the overall Project Schedule to the General Contractor as outlined within Specification 019113 Section 2.1 – Project Schedule.
4. Cx Representative - Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the commissioning program as described in the contract documents. Provide one or two representatives to specifically participate in Commissioning Activities and generally participate in the Commissioning Process. Retain these individuals for the duration of the project to ensure full comprehension and understanding of the scope of commissioning. The Primary Commissioning Representative for the Prime Contractor shall not be changed or replaced for the duration of the project.
5. Cx Meetings - Primary Representative shall attend every Commissioning Meeting.
6. Cx Activities - The subcontractors must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: Mock-Up Inspections, In-Wall Inspections, Above Ceiling Inspections, System Start-up, Equipment Start-up, Duct Pressure Tests, Pipe Pressure Tests, Electrical Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.

7. Issues Log - Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics, Functional Performance Test results or any other commissioning activity.
8. Quality Control Tests – Submit all Quality Control Reports to the General Contractor for upload to Facility Grid. Report files shall be PDF and shall be appropriately labeled to clearly identify contents. Follow Specification 019113 Section 2.5 – Quality Control Reports
9. Pre-Functional Checklists - Complete responsible portions of every PFC. Complete Model Verification section of PFC's for responsible discipline by confirming the installed equipment and components match the approved submittals. Verify completion of assigned portion by second tier subcontractors, vendors, manufactures and/or third party test agencies.
10. Pre-Verification Tests – Complete responsible portions of every PVT. Verify completion of portions of the PVT's needed to be completed by second tier subcontractors, vendors, manufacturers and/or third party test agencies. PVTs are developed and housed online in Facility Grid. Forms are to be completed electronically via the Facility Grid website. Remedy all contractual deficiencies for non-conformance with contract documents identified through Pre-Verification Testing and other verification tests.
11. Functional Performance Tests - Coordinate and execute responsible portions of every FPT as done for the PVT's but with the CxA and other members of the Cx Team to witness. Functional Performance Testing is to be executed after successful execution of the PVT's. This includes the remedy all contractual deficiencies for non-conformance with contract documents identified through Pre-Verification Testing and other verification tests. All such deficiencies are to be remedied prior to inviting the Commissioning Agent and other members of the Cx Team to witness execution of the FPT which is the final system test.
12. Training - Coordinate and execute all responsible Training Activities. Coordinate second tier sub-contractors, vendors and manufacturers to submit all training materials for approval, schedule associated training and document execution and attendance. Training to be executed according to Specification 019113 Section 3.14 – Systems and Equipment Training.

1.5 SYSTEMS INCLUDED IN COMMISSIONING

- A. The following systems are included in Commissioning. Equipment and Descriptions within the table below are a generalized sample description of the system and components. Every component of each system actually included within this project is included within the scope of commissioning. PFC column indicates if PFC's are to be provided for the associated system equipment and components. FPT column indicates if functional testing will be performed for the associated system equipment and components.

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SYSTEM	EQUIPMENT & DESCRIPTION	PFC	FPT
Plumbing Systems			
Domestic Water Heating System	Lavatories, Sinks, Showers, Mixing Valves, Water Heaters, Pumps, Piping, Associated Controls	Yes	Yes
Process Exhaust Systems			
General Exhaust Systems	Fans, Ductwork, VFD's, Associated Controls	Yes	Yes
Kitchen Exhaust Systems	Fans, Ductwork, Kitchen Hoods, VFD's, Associated Controls	Yes	Yes
Terminal Equipment			
General Terminal Units	Terminal Units used to support Central Station AHU's, Fan Powered Units, Reheat Coils, Humidifiers, Ductwork, Associated Controls	Yes	Yes
Terminal AC Components	AC units used to support local climate condition; Humidifiers, Radiators, Unit Heaters, Fan Coils Units, Associated Controls	Yes	Yes
Packaged Air Conditioning Systems			
Central Air Conditioning Systems	Modular, Packaged, & Rooftop AHU's, Split A/C Systems, Supply & Return Fans, Coils, Humidifiers, Ductwork, VFD's, & Associated Controls	Yes	Yes
Split A/C Systems	Split A/C Systems, Variable Refrigerant Systems, Ductwork, Piping & Associated Controls, etc.	Yes	Yes
Instrumentation & Controls			
Energy Management & Control System (EMCS)	Overall Control System Test to verify the interconnected systems are integrated together properly and proper graphics are displayed, Verify Sequences, GUI, Etc.	Yes	Yes

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SYSTEM	EQUIPMENT & DESCRIPTION	PFC	FPT
Building Pressurization & Control System	Overall Control System Test to verify the HVAC systems are integrated together properly to achieve zone pressurization throughout the various sequences and modes of operation.	Yes	Yes
Lighting Controls			
Scheduled Lighting Controls	Fixtures, Switches, Timers, Light Sensors	Yes	Yes
Occupancy Sensor Controls	Control Panels, Sensors, Fixtures	Yes	Yes
Protective Systems (Life Safety)			
Smoke Control and Evacuation Systems	Fans, VFDs, Dampers, Control Panels, HVAC Integration, Associated Controls (via Special Inspectors)	Yes	Yes

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the contractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
 - 1. Quality Control Plans and Tests
 - 2. Equipment and Systems Start-Up

3. Pre-Functional Checklist Completion
 4. Third Party Testing
 5. Pre-Verification Testing
 6. Functional Performance Testing
 7. Training and Orientation
 8. Close-Out Document Review (O&M's, Systems Manual, As-Builts, Warranties)
- D. The Commissioning Agent is to be considered a Third Party Test and Inspection Agency. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. However, these services are not inherently included within the scope of the Commissioning Agent.
1. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, additional inspections due to false PFC's, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at a rate of \$165/hour (including travel time), plus expenses, and the Owner will deduct this cost from the General Contractor's Application for Payment.
 2. The General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

PART 2 - PRODUCTS

2.1 PROJECT SCHEDULE

- A. General Contractor shall submit the overall project schedule and regular schedule updates to the Commissioning Agent as they are provided to the Owner and Designers, typically on a monthly basis.
- B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule. Activities include:
 1. Quality Control Tests
 2. Electrical Energization Milestones
 3. Equipment and Systems Start-Up

4. Third-Party Testing
5. Close-Out Inspections
6. Pre-Verification Tests
7. Functional Performance Tests
8. Training and Orientation

2.2 SUBMITTALS

- A. Contractor(s) shall submit all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within this specification section. Submittals to be provided include:
 1. Manufacturer's Product Data
 2. Manufacturer's Installation Instructions
 3. Shop Drawings
 4. Coordination Drawings
 5. Qualification Data
 6. Quality Control and Third-Party Test Reports
 7. Electrical Energization Schedule
 8. Start-Up Plan and Equipment Start-Up Reports
 9. Controls Calibration Instructions - The Contractor(s) shall provide calibration instructions for each type of control device to be installed. Submit only control device calibration instructions for devices which have been approved by the Designers.
 10. Operations and Maintenance Manuals
 11. Systems Manual
 12. Red-Lines/Record As-Built Documents
 13. Training Plan, Agendas, Schedule and Records
 14. Equipment and System Warranties

2.3 QUALITY CONTROL PLAN

- A. The General Contractor shall assemble a Quality Control Plan which specifically summarizes all of the Quality Control Inspections and Tests within the various specification sections. The Quality Control Plan shall indicate:

1. Component/Equipment Description
 2. Specification Section
 3. Quality Control Test/Inspection Description
 4. Entity Conducting Quality Control Test/Inspection
 5. Whether the QC activity is required to be Witnessed
 - a. If the QC activity is required to be Witnessed, list the Witness agency
 6. Number of Tests/Inspections to be Conducted
 - a. This Number may increase or decrease as a result of installation progress
 7. Number of Tests/Inspections Conducted and Reports Provided
 - a. Number of Reports Provided must match the Number to be Conducted to indicate the task is complete.
- B. The Quality Control Plan is to be updated regularly to reflect current Number of Tests/Inspection to be Conducted and current Number of Test Reports Provided. Plan to be regularly updated and distributed to the Commissioning Team. See 019113 Section 3.7 – Quality Control Reporting for procedure details.

2.4 QUALITY CONTROL REPORTS

- A. Contractor(s) shall submit copies of all inspection and test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall include but are not limited to: specialty inspections, pressure tests, leakage tests, flushing and cleaning, chemical treatment, equipment repair, electrical equipment tests, TAB reports, gauge calibration, etc.
- B. Quality Control Reports is detailed throughout each individual system component and equipment specification. At a minimum, each Quality Control Report content shall include:
1. System and Equipment being inspected or tested
 - a. Partial system/equipment tests must be detailed sufficiently to demonstrate the exact limits of the test. For example, a duct leakage test must identify exactly without question, what section of duct is being tested.
 2. Description of field quality control inspection or test
 3. Date of field quality control inspection or test
 4. Contracting Company executing field quality control inspection or test

5. Individual Company Representative executing field quality control inspection or test
 6. Inspection or test Pass Criteria
 7. Inspection or test Findings, Readings and Measurements
 8. Inspection or test Results
- C. Quality control reports are to be submitted through the normal submittal procedures, reviewed by the design team and commissioning agents for approval. Reports are to be submitted within two weeks (14 Days) of the quality control activity being executed.
- D. The final approved reports are to be uploaded to Facility Grid by the General Contractor. Approved start-up reports are to be uploaded to facility grid within two weeks (14 days) of the approval by the design team via the submittal process. Reports are to be PDF files. PDF files are to be named using the following nomenclature:
1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

2.5 PRE-FUNCTIONAL CHECKLISTS

- A. The contractor shall develop PFC's for every piece of equipment and system component included within the systems outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.
- B. It is the contractor's responsibility to estimate the extent and depth of the PFC requirements, based upon the level of involvement required to install each individual piece of equipment or system component.
- C. The number of checklist items for each piece of equipment or system component shall range anywhere from 30 checklist items up to 100 checklist items depending upon the level of involvement and the way the equipment is broken down. For example, a strainer may have 10 checklist items associated with it, but several strainers may be grouped onto a single PFC for a whole system, such that that PFC has up to 200 checklist items. A single piece of equipment that has more installation requirements such as a VAV Terminal Unit with Hydronic Reheat may have numerous components whose checklist items total 100. PFC's should be anticipated to have an average of 65 checklist items to be completed by the installing contractors for every piece of equipment.
- D. The contractor shall submit drafts of each PFC form via the submittal process for review and approval. Once approved, the forms are to be duplicated for each piece of equipment. Forms are then to be completed by the contractor with direct knowledge of each specific checklist items. Forms are to be completed prior to execution of the Functional Performance Tests.
- E. PFC content is as follows:
1. Equipment PFC's shall list for comparison the manufacturer's data of the equipment as per the design, approved submittal and the installed equipment. These three items are

initially blank on the forms developed by the contractors. The Contractors are then responsible for obtaining this information and filling in these blanks.

- a. Design: The manufacturer's data shall be filled in by the contractor according to the design criteria outlined within the design specifications or equipment schedules.
 - b. Submitted: The manufacturer's data shall be filled in by the contractor according to the product submittal, submitted by the contractor and approved of by the design representative
 - c. Installed: The manufacturer's data shall be filled in by the contractor according to the actual piece of equipment installed in the field nameplate data.
2. PFC's include checklist items requiring submittals to be completed. Submittals that are not product submittals provided to the System Design Professionals for review and approval are to be attached to the PFC.
 3. The majority of each PFC's is the installation checklist items required to be verified by the installing contractor. Final checks include verification that start-up, testing and balancing has been properly performed.
 4. Some PFC's for operating equipment may include a handful of start-up readings to ensure start-up has been conducted. These readings do not require a second or redundant effort but can be transposed from a start-up report or TAB report.

2.6 ELECTRICAL ENERGIZATION PLAN

- A. The General Contractor shall work with the Electrical Contractor to oversee, plan and schedule all electrical system component testing and electrical system energization.
- B. The GC will provide a Electrical Test and Energization Plan which details each activity from the first electrical test to the final electrical component energization. The plan shall indicate:
 1. Full list of Electrical Components to be tested and energized.
 2. Date of each component installation completion.
 3. Date of each component NETA Testing.
 4. Date of each component energization.
 5. Date of Quality Control Testing
- C. Electrical Test and Energization Plan shall indicate dependencies, such as components downstream from another which cannot be powered before the upstream component.
- D. The Electrical Test and Energization Plan is to be updated weekly and distributed to the Commissioning Team throughout the Electrical Test and Energization phase. See 019113 Section 3.4 – Electrical Testing and Energization for procedure details.

2.7 SYSTEMS AND EQUIPMENT START-UP PLAN

- A. The General Contractor shall work with the various subcontractors to oversee, plan and schedule all system and equipment energization and start-up activities.
- B. The CM/GC will provide a Systems and Equipment Start-Up Plan which details each activity from the first electrical component energization to the last controls component start-up. Each system energization and start-up activity is to be tracked. The plan shall indicate:
 - 1. Contractor performing Installation
 - 2. Date of installation complete
 - 3. Date of energization (power available)
 - 4. Contractor performing quality control (NETA, TAB, etc.)
 - 5. Date of Quality Control Testing
 - 6. Contractor performing start-up
 - 7. Date of start-up
- C. Systems and Equipment Start-Up Plan shall indicate dependencies, such as equipment start-ups which cannot occur until associated power energization is complete.
- D. The Systems and Equipment Start-Up Plan is to be updated weekly and distributed to the Commissioning Team throughout the Energization and Start-Up phase. See 019113 Section 3.5 – Systems and Equipment Start-Up for procedure details.
- E. Systems and Equipment Start-Up Plan shall show systems and equipment dependent upon Electrical Systems for power. The Plan shall show systems and equipment dependent on Plumbing Systems for water supply. The Plan shall show systems and equipment dependent upon Mechanical Systems for air conditioning and dehumidification as well as other mechanical systems for heat rejection. The Plan shall show systems and equipment dependent upon Communication Systems for integration and automation purposes.

2.8 CONTROLS START-UP RECORDS

- A. Controls Start-Up consists of energizing the controls system, uploading programming, verifying each sensing device reports back to the controls system correctly (point-to-point), verifying each modulating device is controlled by the control system correctly (point-to-point), verifying each sensor is correctly calibrated, and each control PID loop is correctly tuned. As such reports for these activities are to be submitted to ensure they have been performed completely.
- B. Controls Start-Up Records are to be formally submitted and once approved, posted to Facility Grid. See 019113 section 2.5 - Quality Control Reports for details.

C. Calibration Records

1. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device.
2. Calibration records are to be submitted, reviewed and approved. Approved calibration records are to be uploaded to Facility Grid for the final commissioning records. Alternatively, calibration measurements may be recorded on the associated PVT form if fields are available.

D. Point-to-Point Checkout

1. All controls points require Point-to-Point Records where each device is individually checked to report back to the controls front end for correct labeling, value and representation.
2. Point-to-Point Reports are to be submitted, reviewed and approved. Approved point-to-point records are to be uploaded to Facility Grid for the final commissioning records. Alternatively, point-to-point tests may be recorded on the associated PVT form if fields are available.

E. Loop Tuning

1. Controls PID loops all require individual tuning to verify correct response, minimal overshooting and zero hunting by the controls system. Loop tuning records list the final PID values as determined by the controls programmer.
2. PID Loop Tuning Reports are to be submitted, reviewed and approved. Approved loop tuning records are to be uploaded to Facility Grid for the final commissioning records. Alternatively, loop tuning tests may be recorded on the associated PVT form if fields are available.

2.9 START-UP REPORTS

- A. Contractor(s) shall submit copies of all equipment start-up reports for every system to be commissioned. Start-up reports are to be completed as required by various equipment specifications. Start-up is to be performed by certified technicians, contractors or manufacturers as required. Start-up technician is to complete report which identifies checklist items, procedures and readings performed at start-up. Reports include the name and company of the start-up technician, contact information and date of activities.
- B. Start-up reports are to be submitted through the normal submittal procedures, reviewed by the design team and commissioning agents for approval. Reports are to be submitted within two weeks (14 days) of the start-up activity.

- C. The final approved start-up reports are to be uploaded to Facility Grid by the General Contractor. Approved start-up reports are to be uploaded to facility grid within two weeks (14 days) of the approval by the design team via the submittal process. Reports are to be PDF files. PDF files are to be named using the following nomenclature:

1. Start-Up Report – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

2.10 PRE-VERIFICATION TESTS

- A. PVT's are identical copies of the Functional Performance Tests. PVT's are FPT versions created for the Contractor's use in pre-testing the various Commissioned Systems. Where FPT's include sections for spot-checking system components, PVT's will include full test sections for 100% component testing. On Facility Grid, Contractors will have access to complete the PVT's but will not have access to complete the FPT's.
- B. See Functional Performance Tests for more PVT content description.

2.11 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT) shall be provided for every system included within the systems outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning. Systems may be split into several FPT's at the discretion of the Commissioning Agent to facilitate efficient testing.
- B. It is the contractor's responsibility to estimate the extent and depth of the FPT requirements, based upon the level of involvement required to test the entire system.
- C. Each system FPT shall consist of a multitude of operational procedures which shall encompass all operational procedures for which that system is required to be capable of performing per the contract documents. Each FPT is customized for each system according to the specifications, contract drawings and equipment submittals.
- D. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth.
1. Functional Performance Tests shall be composed of a very detailed series of step-by-step procedures required to be performed by the installing contractors in order to prove the sequence of operations has been properly met according to the construction documents.
 2. FPT's shall include functional test procedures for each operational piece of equipment within a system. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. These shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not

fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.

3. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.
4. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.
5. Redundant Equipment – A Functional Performance Test shall be provided to test every piece of redundant equipment. However, all redundant equipment shall not necessarily be retested as part of the FPT's and witnessed by the Commissioning Agent. Rather, the Commissioning Agent will randomly select redundant equipment to be tested. See specification 019113 section 3.10-H for additional information regarding Functional Performance Testing of redundant equipment.

2.12 SYSTEMS AND EQUIPMENT TRAINING PLAN

- A. The General Contractor shall assemble a Systems and Equipment Training Plan which specifically summarizes all of the Systems and Equipment Training requirements from the project specifications. This includes general training procedures, schedule, coordination, locations, methods, etc. The Systems and Equipment Training Plan shall indicate:
 1. Training Procedures and Requirements
 2. General Contractor Representative who is managing Training Process
 3. Contractors Responsible for Providing Training
 4. Contractors/Vendors/Manufacturers actually Performing Training including both Company, Individual Name and Contact Information.
 5. Qualifications of the Individual Performing the Training
 6. Contractors providing Training Assistance, such as Videographers
 7. Training Summary:

- a. Within the Training Plan, the General Contractor shall include a Systems and Equipment Training Summary Table which specifically summarizes all of the individual Systems and Equipment Training requirements from the various specification sections. The Systems and Equipment Training Summary shall indicate:
 - b. Component/Equipment Description
 - c. Complexity Level of Training to be delivered. Complexity can be divided into any number of levels. Each level is to be defined within the Training Plan. Complexity must range from:
 - 1) Least Complex: Simple operational training where it is assumed all maintenance and service will be contracted out.
 - 2) Most Complex: Full operational, maintenance and service training where it is assumed none of the maintenance and service will be contracted out, but that the Owner's O&M Staff will perform all of it.
 - d. Number of Training Sessions (to accommodate various trades or various shifts.)
 - e. Number of Specified Hours for individual training sessions.
 - f. Entity Conducting that Training Session
 - g. A Checklist items that demonstrates the associate O&M submission has been complete and approved.
 - h. A checklist items that demonstrate the Training Session is complete and possibly documents the date of the training session.
 - i. A checklist item that demonstrate the Training Records of that training session have been complete, submitted and approved. Training Records include Training Agenda, Training Sign-In Sheet and any other product of the training such as Training Video or Training Quiz.
- B. See 019113 Section 3.14 – Systems and Equipment Training for procedure details.

2.13 TEST AND PROPRIETARY EQUIPMENT

- A. All industry standard test equipment required for performing the specified tests shall be determined by the Contractor as needed to complete the Controls Start-Up, Equipment Start-Up, Systems Start-Up, Pre-Verification Tests and Functional Performance Tests. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.
- B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the Contractor to the Commissioning Team for PVT and FPT execution.
- C. The instrumentation provided by the contractor shall meet the following standards:

1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
 2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument
 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
 4. Be immediately replaced if dropped and/or damaged in any way during use on this project.
- D. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed.
- E. Proprietary test equipment (and software) needed for regular operation, settings adjustment, service and maintenance intended to be performed by the Owner's O&M Staff shall be included within the scope of this project to be turned over and become the property of the Owner upon completion of the project.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND KICK-OFF MEETING

- A. Each Contractor is to provide the contact information for their Commissioning Representatives. The Commissioning Agent will add each Commissioning Representative to the online Commissioning database Facility Grid. Some team members may have previously utilized Facility Grid and in their case will have existing login credentials. For those new to Facility Grid, new credentials will need to be set-up by each team member upon their first login attempt. RMF will confirm once every Contractor's Representative has setup their Facility Grid account.
- B. The Commissioning Agent will distribute the Draft Commissioning Plan to the Commissioning Team once these contacts are identified. The Plan will be distributed utilizing Facility Grid. The CxA will post the Plan to Facility and send notifications to the Commissioning Team which will include a link to the document.
- C. The Commissioning Kick-Off Meeting will be held and attended by all Contractors Commissioning Representatives involved in the commissioning process. The Draft Commissioning Plan will be reviewed at this meeting outlining the specific commissioning process for this project, the overall project schedule and scheduled commissioning activities and the names and contact information of each of the Commissioning Representatives. The CxA will not print a copy of the Cx Plan for every attendee. Rather, each attendee is welcome to print their own copy and the CxA will review the Cx Plan via a presentation screen.

- D. After the Commissioning Kick-Off Meeting, the Commissioning Plan will be updated based upon the discussions at the Commissioning Kick-Off Meeting if any changes are required. The Final Commissioning Plan will be issued soon after the meeting.

3.2 CONSTRUCTION OBSERVATIONS

- A. The Architect and System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner. The Designers are the official inspectors of record for in-wall, above-ceiling and final inspections.
- B. The Commissioning Agent will additionally perform construction observations throughout the project construction phase. The Commissioning Agent will coordinate these site visits with the General Contractor. Site visits will include progress reporting, observed means and methods, as well as observed deficiencies.
- C. The General Contractor is responsible for notifying the Designers and Commissioning Agent of upcoming commissioning activities such that they may schedule their upcoming site visits to coincide with said activities. Activities include quality control tests, in-wall and above-ceiling inspections, start-ups, etc.
- D. The Commissioning Agent will provide a Report for each Site Visit which identifies what was observed as well as any deficiencies. Deficiencies will be listed on the associated Site Visit Report and logged on the Issues Log for tracking.

3.3 MOCK-UPS

- A. Mock-ups and any other installation sample shall be scheduled in advance and coordinated with the entire Commissioning Team. Mock-up schedules will be regularly updated and the Commissioning Team will be given fourteen (14) calendar days advance notice of the scheduled completion of the mock-up such that it is ready for inspection.
- B. Any mock-ups which require intermediate inspection shall be provided with similar advance notice; fourteen (14) calendar days. Mock-up construction will halt at the intermediate point to accommodate the scheduled inspection such that the portion of the mock-up to be inspected remains exposed.
- C. Any mock-ups which require field testing shall be completed and allowed to cure for the pre-requisite time period as defined by the materials of construction. Field test schedule shall be based on the end of the cure time to ensure there are no exceptions to the field test. Field tests for mock-ups shall be given a similar advance notice of fourteen (14) calendar days.

3.4 ELECTRICAL TESTING AND ENERGIZATION

- A. The General Contractor shall work with the Electrical Contractor to oversee, plan and schedule all electrical system component testing and electrical system energization activities with continuous reporting and updating to the entire Commissioning Team.

- B. The CM/GC will provide a Electrical Test Plan which details each individual test activity and which contractor is going to perform it. See 019113 Section 2.7 – Electrical Test Plan for plan content requirements.
- C. The CM/GC will provide a Electrical Energization Plan which details each individual activity from the first electrical component fully installed, to the final electrical component energization. See 019113 Section 2.8 – Electrical Energization Plan for plan content requirements.
- D. Electrical Test Plan and Electrical Energization Plan to be submitted for formal review a minimum of sixty (60) calendar days prior to the first anticipated electrical test activity. This allows for at least two (2) formal reviews before electrical test and energization activities begin. Submission of plans which shows testing or energization occurring within sixty (60) days shall be adequate reason for revision of these submittals.
- E. Starting one (1) week prior to the first scheduled electrical test activity, the Electrical Energization Plan is to be updated and distributed to the Commissioning Team. Upon the beginning of testing and energization activities, the Electrical Energization Plan shall be updated on weekly basis. Each activity and dependent activity must be updated accordingly. The CM/GC will continuously update the Electrical Test and Energization Plan and distribute the updated plan to the Commissioning Team each week throughout the completion of electrical testing and energization.
- F. Updated Electrical Energization Plan information is to be transcribed on a weekly basis to the Systems and Equipment Start-Up Plan in order to keep the rest of the contractors on the Commissioning Team apprised of the latest energization schedule which has a direct impact on the systems and equipment start-up.

3.5 SYSTEMS AND EQUIPMENT START-UP

- A. The General Contractor shall oversee, plan and schedule all system energization and start-up activities with continuous reporting and updating to the entire Commissioning Team.
- B. The CM/GC will provide a Systems and Equipment Start-Up Plan which details each activity from the first electrical energization to the final component start-up. See 019113 Section 2.9 – Systems and Equipment Start-Up Plan for plan content requirements.
- C. Systems and Equipment Start-Up Plan to be submitted for formal review a minimum of sixty (60) calendar days prior to the first anticipated energization or start-up activity. This allows for at least two (2) formal reviews before energization and start-up activities begin. Submission of a schedule which shows energization or start-up occurring within sixty (60) days shall be adequate reason for revision of this submittal.
- D. Starting one (1) week prior to the first scheduled energization activity, the Systems and Equipment Start-Up Plan is to be updated and distributed to the Commissioning Team. Upon the beginning of Energization and Start-Up activities, the Systems and Equipment Start-Up Plan shall be updated on weekly basis. Each activity and dependent activity must be updated accordingly. The CM/GC will continuously update the Systems and Equipment Start-Up Plan and distribute the updated plan to the Commissioning Team throughout the completion of energization and start-up.

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- E. The General Contractor shall oversee the energization of the electrical systems of the building and coordinate such with all equipment and system start-ups. Equipment and System start-ups cannot occur until the electrical system supporting their associated power are complete, tested and approved for energization by the Designers and any AHJ Inspections. Once the Designers and AHJ have inspected and approved the electrical systems for energization, they may be energized thus allowing equipment and systems start-up to comments. With a large building, energization will undoubtedly be staggered. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule.
- F. The General Contractor shall oversee the energization of the plumbing systems of the building and coordinate such with all equipment and system start-ups. The Plumbing Systems often support various hydronic Mechanical Systems and equipment such that those hydronics systems can only be energized to run continuously for tuning, adjustment or temporary operation if the associated plumbing system is energized and fully functional. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule.
- G. The General Contractor shall oversee the energization of the mechanical systems of the building and coordinate such with all equipment and system start-ups. The Mechanical Systems often support various Electrical and Telecommunication Systems and equipment such that they can only be energized to run continuously if air conditioning of sensitive equipment spaces is provided. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule. Additionally, special approval is needed to energize these systems prior to Substantial Completion. See Specification 019113 Section 3.6 – Temporary Utilization for more information.
- H. The General Contractor shall oversee the energization of the communication systems of the building and coordinate such with all equipment and system start-ups. The Communications Systems often support the operation of various systems and equipment such that they can only be energized to run continuously and under automatic control for tuning, adjustment or temporary operation if the associated communications system is energized and fully functional. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule.
- I. Upon completion of each Energization and Start-Up Activity, the responsible Contractor shall formally submit through the General Contractor a record of the activity. Equipment and System Start-Up Reports shall be submitted within fourteen (14) calendar days of the associated start-up activity execution.
- J. Approved Reports are to be posted to Facility Grid by the General Contractor as PDF files within fourteen (14) calendar days of the submittal approval utilizing the following file naming convention where the date of the file is the date of the executed activity:
 - 1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

3.6 TEMPORARY UTILIZATION

- A. No new or final equipment or systems are to be utilized for Temporary means by the Construction Management, General Contractors or Subcontractors. Temporary utilization is generally not allowed and any temporary power, HVAC, plumbing, internet, etc. shall be provided as a temporary system by the Contractors. Temporary utilization of any new, permanent systems or equipment must be formally requested by the Contractors via the formal submittal process and must include a Preventative Maintenance Plan. See 2.12 – Preventative Maintenance Plan for plan content requirements.
- B. Perform regular observations of temporary operating systems and equipment. Document and log observations as prescribed in the approved Preventative Maintenance Plan with personnel performing observation, observations results and date of observations.
- C. Perform regular maintenance activities on temporary operating systems and equipment as prescribed by the approved Preventative Maintenance Plan. Document and log maintenance activities utilizing forms within the Plan.
- D. Records must be maintained to demonstrate full compliance with the approved Preventative Maintenance Plan. Without full records for any or all components of a system, may result in deficiencies preventing acceptance of those systems or components.
- E. It is ultimately the contractors responsibility to turn over to the owner, equipment and systems in New condition. Any wear, tear or other damage to systems and equipment during the construction process, whether a result of temporary use, lack of maintenance or other, is the contractors responsibility to remedy.
- F. Full warranty start dates must occur upon final project acceptance. Any vendors or manufacturer's who start their warranty upon the start-up of the equipment for use, whether temporary or not, must provide extended warranties such that the full contract warranty is provided upon final acceptance. Warranty plans, warranty start-dates and/or extended warranties must be formally submitted to the Commissioning Team prior to approval for temporary utilization or final acceptance.

3.7 QUALITY CONTROL REPORTING

- A. The General Contractor shall work with the various subcontractors to oversee, plan and schedule all field quality control tests with continuous reporting and updating to the entire Commissioning Team.
- B. The CM/GC will provide a Quality Control Plan which details each activity from the first electrical test to the final electrical component energization. See 019113 Section 2.4 – Quality Control Plan for plan content requirements.
- C. The CM/GC will ensure all Quality Control Reports are generated for every Quality Control Inspection and Test which details each activity. See 019113 Section 2.5 – Quality Control Reports for minimum report content requirements.

- D. Quality Control, Third-Party Test and Start-Up Reports are to be submitted to the entire Construction Team via the agreed upon submittal routing method. These reports are to be submitted to the Team within fourteen (14) calendar days of the execution of the associated activity. Similar tests are to be submitted individually. Similar reports may be grouped together and submitted as a package only upon the approval of the Commissioning Team. Every report is to be formally reviewed by the Designers and Commissioning Agent for approval.
- E. Approved Reports are to be posted to Facility Grid by the General Contractor as PDF files within fourteen (14) calendar days of the submittal approval utilizing the following file naming convention where the date of the file is the date of the executed activity:
 - 1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

3.8 PRE-FUNCTIONAL CHECKLISTS

- A. Pre-Functional Checklists (PFC) shall be developed by the Contractors after the associated submittals have been reviewed and approved. PFC's will be distributed to the Commissioning Team via electronic format (PDF or other.)
- B. PFC's require no additional installation work above and beyond the scope of the contract documents. PFC checklist items shall be checked-off as equipment is being installed according to the project schedule. PFC's shall be completed in conjunction with the completion of equipment installations.
- C. PFC's may be reviewed and commented on by the Commissioning Team.
- D. PFC's are multi-discipline and therefore must be partially completed by multiple contractors. The division of each PFC is the contractor's responsibility. Division of project work is determined by the General Contractor and Subcontractors and is not within the jurisdiction of the Commissioning Agent. Therefore, the division of work outlined within each PFC is generalized and has not taken into account the true scope of each individual sub-contracting company. Each contractor must review every PFC to determine their own obligation to the installation checklist items described therein.
- E. PFC's shall include full calibration documentation of all field calibrated devices as required by the specifications of equipment or controls. Calibration may be recorded on the PFC form if fields are available. Alternatively, calibration records can be submitted as an attachment to the PFC. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device.
- F. PFC's are to be fully completed prior to the beginning of scheduled Functional Performance Testing for any given system. i.e. Air Handling Unit PFCs as well as associated Ductwork and Controls, must be fully complete prior to the scheduled Functional Testing of the Air Handling Unit System. However, for example, AHUs do not necessarily preclude testing of the Chilled Water System. The Commissioning Team is to be given a minimum of seven (7) calendar days notice of the completion of the PFC's for any given system prior to the scheduled start of the associated Functional Performance Test.

3.9 PRE-VERIFICATION TESTS

- A. Pre-Verification Tests (PVT's) shall be issued by the Commissioning Agent to the Commissioning Team. PVT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.
- B. Subcontractors, Vendors, Manufacturers and Third-Party Test Agencies complete the PVT's under the direction and coordination of the General Contractor.
- C. PVT's are to be fully and successfully completed prior to scheduling FPT's. All issues discovered while performing a particular PVT are to be corrected such that the PVT can be successfully completed prior to scheduling the associated FPT. The Commissioning Team is to be given a minimum of seven (7) calendar days notice of the completion of the PVT for any given system prior to the scheduled start of the associated Functional Performance Test.

3.10 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT) shall be issued by the Commissioning Agent after the associated submittals have been reviewed and approved. FPTs will be distributed to the Commissioning Team via electronic website database called Facility Grid.
- B. FPT's shall not require an extension of the project schedule but shall be integrated into the original overall Master Project Schedule. FPT's require no additional installation work above and beyond the scope of the contract documents. FPT's generally include a repeat of quality control checks already required by the construction documents.
- C. FPT's may be reviewed and commented on by the Commissioning Team. Comments must be received within thirty (30) calendar days of the FPT being generated on Facility Grid. FPT's may be modified slightly during the execution of the PVT's. However, once FPT's have begun to be filled out by the Commissioning Agent, the FPT's will not be further revised. Any necessary changes to the FPT must be reported to the Commissioning Team a minimum of seven (7) calendar days prior to the scheduled beginning of the associated FPT. Changes must be minor enough to be effected within the seven (7) day period.
- D. Means and Methods – Upon the posting of each Functional Performance Test to Facility Grid, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team with any issues or discrepancies found with the Functional Performance Test. This includes means and methods. It is ultimately up to the contractor to determine the safest way to perform each test. Any devices, sequences or alarms thought to be “un-testable” must be reported to the Commissioning Team during the agreed upon FPT Review Period.
- E. Functional Performance Tests are to be executed by the installing contractors, vendors, manufacturers or third-party test agencies and witnessed by the Commissioning Agent. The entire Commissioning Team is also to be appraised of the test schedule with the option of witnessing testing. Functional Performance Testing is not to be executed by parties who are not responsible for the installations or have direct knowledge of the installations and operation of the system.

- F. Upon the beginning of FPT execution, changes or procedures not already corrected but not capable of testing will result in FPT failures, possible termination of FPT execution as determined by the Commissioning Team, project delays and retesting. Costs associated with any delays, retesting or other work resulting from such test failures will be directed to the party responsible for not bringing these issues to the Commissioning Team in advance. See specification 019113 section 1.6-D for additional information.
- G. Test Two Times – The contractor must account for performing each Functional Performance Test two (2) times. The Functional Performance Test is duplicated on Facility Grid. The version to be executed by the Contractors without witnessing by the Commissioning Team is called the Pre-Verification Test. These are identical to the Functional Performance Tests and must be completed by the Contractors prior to scheduling the Functional Performance Tests which is to be witnessed by the Commissioning Team. See 019113 Section 2.13 – Pre-Verification Tests
- H. The contractor shall be responsible for testing every piece of equipment to verify correct operation via the PVT's. However, all redundant equipment shall not necessarily be retested as part of the FPT's and witnessed by the Commissioning Agent. Rather, the Commissioning Agent will randomly select redundant equipment to be tested at a test rate of twenty percent (20%), rounded up.
1. i.e. If there are twenty-one (21) pieces of equipment, four (4) pieces of equipment would be 19% and five (5) pieces would be 24%, since 19% is less than 20%, five (5) pieces of equipment would be tested. This is how the random redundant testing should be estimated.
 2. Equipment to be sampled shall be chosen at random by the Commissioning Agent, during functional testing. A failure of five percent (5%) or more of the randomly selected equipment shall indicate improper installation, start-up or tuning. This will result in the test being considered a failure.
 3. Upon failure of a system consisting of a random sampling, the full test will have to be repeated on a new random selection of equipment. Prior to retesting with the Commissioning Team, the entire collection of 100% of the equipment must be revised by the Contractors and a new, revised, updated PVT submitted. Upon receipt of the revised PVT, the FPT can once again be rescheduled.
 4. Upon failure of the same system twice, the random selection of the equipment will double (x2) to forty percent (40%). Upon failure of the same system three times, the random selection of the equipment triple (x3) to sixty percent (60%.) A fourth failure will require 100% of the system to be witnessed by the Commissioning Agent. The cost associated with this retesting including contractors and Commissioning Agents costs will be passed along to the responsible contractor. See specification 019113 section 1.6-D for additional information.

3.11 TAB VERIFICATION

- A. The Test, Adjustment and Balance (TAB) Contractor has several Quality Control Report requirements.

1. The TAB Contractor may be required to perform Duct Leakage testing.
 2. The TAB Contractor is required to provide a Qualifications Submittal.
 3. The TAB Contractor is required to provide a TAB Plan to identify their approach to the very specific systems within this project.
 4. The TAB Contractor is required to inspect the system installations and provide Inspection Reports prior to beginning actual field adjustments and measurements to ensure there are no deficiencies which will impair TAB from performing their work successfully.
- B. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent. The TAB Contractor shall be required to repeat measurements selected by the Commissioning Agent to confirm the accuracy of the submitted report. See Specification 230800 – Commissioning of Mechanical Systems for details. TAB Verification shall be included within the scope of the Functional Performance Testing. See Specification 019113 – 3.10-H for details regarding redundant equipment spot-check tests.

3.12 INTEGRATED SYSTEMS TEST

- A. The General Contractor shall organize, plan and oversee the execution of an Integrated Systems Test (IST.) The IST is conducted by a full building power outage test, typically occurring at the primary service transformer. Often the utility company must accommodate the power disconnection.
- B. The IST generally consists of verifying all of the building systems work together in harmony. During the power outage and restoration, every individual system is reviewed and analyzed for performance.
- C. The Integrated system Test is to be scheduled to occur after all other functional testing is complete and issues resolved. The IST is a final building functional test. The IST is to be Created and Documented by the Contractor(s). Witnessing of the IST is not included by the Commissioning Agent.

3.13 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractors will submit all O&M Manuals on a timely basis, individually within thirty (30) calendar days after the approval of the associated product and shop drawing submittals. O&M Manuals are to be formally submitted for review by the entire Commissioning Team.
- B. In accordance with North Carolina Building Energy Code, O&M Manuals for Systems and Equipment included within the Systems to be Commissioned must include:
 1. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.

2. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance. except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
 3. Name and address of at least one service agency
 4. HVAC and service hot water controls system maintenance and calibration information, including wiring diagrams, schematics and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in system programming instructions.
 5. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
 6. Operation and maintenance manuals for each piece of lighting equipment. Required routine maintenance actions, cleaning and recommended relamping shall be clearly identified
 7. A schedule for inspecting and recalibrating all lighting controls.
 8. A narrative of how each system is intended to operate, including recommended set points.
- C. O&M's are to be retained and maintained by the Construction Manger/General Contractor and ultimately assembled into a full project record O&M collection. The final O&M collection is to be submitted for approval once every individual O&M has been reviewed and approved and the associated systems have been functionally tested such that the systems are reported to be accepted by the Designers and Commissioning Agent. The final O&M submission will include organized O&M's and associated table of contents, whether they are provided as hard copies or electronic copies.

3.14 SYSTEMS AND EQUIPMENT TRAINING

- A. Training shall be fully specified within the general conditions training specification as well as individual equipment specifications throughout. The General Contractor is responsible for summarizing the training requirements into a concise Training Plan. The Training Plan is to be reviewed by the Commissioning Team via the submittal process for approval. The Training Plan is to include a draft Training Schedule which will be updated toward the completion of the Construction Phase as Functional Testing is scheduled.
- B. Training for any given system or equipment shall not commence until the completion of the Functional Performance Testing of that system and closure of all associated deficiencies.
- C. Each Training Session will be provided with an Agenda, Qualified Training Representative, associated O&M's to be reviewed as part of the training, and a record of attendance. The Agenda, Trainer qualifications and associated O&M's are to be formally submitted as a Training Package for each training session. The individual Training Packages are to be reviewed by the Commissioning Team and approved prior to scheduling the associated training activity.

- D. Starting one (1) week prior to the first scheduled energization activity, the Systems and Equipment Training Summary is to be updated and distributed to the Commissioning Team. Upon the beginning of Training activities, the Systems and Equipment Training Summary shall be updated on weekly basis. Each activity and dependent activity must be updated accordingly. The CM/GC will continuously update the Systems and Equipment Training Summary and distribute the updated plan to the Commissioning Team throughout the completion of Training Activities.
- E. Upon completion of each training activity, the training records, including the Training Package, the attendance log, any associated quizzes and video recordings of the training sessions will all be submitted for final approval. Any partial deficiency including a missing attendance log or a poor video recording may result in rejection of that training session and require the session to be repeated.

3.15 EXCLUSIONS

- A. Means and methods – The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.
- B. Hands-on work – The Commissioning Agent shall not perform any hands-on work or be otherwise responsible for the execution of any installation or test item. The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.16 PREREQUISITES TO SUBSTANTIAL COMPLETION

- A. All commissioning of Systems Included in Commissioning must be complete prior to Substantial Completion. Prerequisites include for all systems, but are not limited to:
 - 1. Completed and signed Quality Control and Start-Up Reports
 - 2. Completed and signed Pre-Functional Checklists
 - 3. Final approved TAB Report
 - 4. Completion of all Functional Testing (with the exception of limited deferred testing.)
 - 5. Completed and approved Training of Owner personnel
 - 6. Submitted and approved final O&M Manual submission
 - 7. All identified deficiencies have been corrected as reported by the Designers, Commissioning Agents, Third-Party Test or Inspection Agencies and the Owner.

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- B. Deferred Testing – Exceptions to this will be identified during the Acceptance Phase if any part of the Functional Testing cannot be conducted due to reasons outside of the Contractors control, such as weather. Additionally, some tests may be deferred due to occupancy requirements such as post occupancy electrical component thermal imaging.
- C. The Owner's Project Manager will determine the date of Substantial Completion and Final Acceptance after reviewing the Commissioning Agent's recommendations.
- D. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

END OF SECTION 019113

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

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

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.

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3. Slag cement.
4. Silica fume.
5. Aggregates.
6. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
7. Vapor barriers.
8. Floor and slab treatments.
9. Liquid floor treatments.
10. Curing materials.
11. Joint fillers.
12. Repair materials
13. Steel reinforcement and accessories.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
11. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
12. Intended placement method.
13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
2. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

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3. Formwork Shop Drawings: Prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.
- E. Floor Slab Protection: Refer to Section 033543 "Polished Concrete Floor Finishing."

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Waterstops.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor barriers.
 11. Joint-filler strips.
 12. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 1. Portland cement.
 2. Fly ash.
 3. Slag cement.
 4. Silica fume.
 5. Aggregates.
 6. Admixtures:

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- a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Preconstruction Test Reports: For each mix design.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field-Testing Technician, Grade 1, in accordance with ACI CP-1 or an equivalent certification program.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code – Reinforcing Steel."

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).
- B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of placement to not exceed 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I Type II or Type I/II. Supplement with the following:
2. Fly Ash: ASTM C618, Class F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Silica Fume: ASTM C1240 amorphous silica.

C. Normal-Weight Aggregates: ASTM C33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
- c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 1 inch nominal.

3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, 1-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 7. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRC C48 at a hydraulic pressure of 200 psi for 14 days.
- G. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 VAPOR BARRIERS

- A. Sheet Vapor Barrier: ASTM E1745, Class A with a water-vapor permeance of less than 0.01 perms after mandatory conditioning (ASTM E1745, Section 7.1); not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Floor Slab Protective Covering: Eight-feet- wide cellulose fabric.

2.7 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use high-range water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, concrete for parking structure slabs, and concrete with a w/cm below 0.50.
 - 4. Use permeability-reducing admixture in concrete mixtures where indicated.

2.9 CONCRETE MIXTURES

- A. Class – Footings: Normal-weight concrete used for footings.
 - 1. Exposure Class: ACI 318 As indicated on drawings
 - 2. Minimum Compressive Strength: As indicated at 28 days.
 - 3. Maximum w/cm: As indicated on drawings
 - 4. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture.
 - 5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
 - a. Exposure Class F1: 4.5 percent, plus or minus 1.5 percent at point of placement for concrete containing 1-inch nominal maximum aggregate size.
 - 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

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- B. Class - Interior Slab-on-Grade: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318 As indicated on drawings.
 2. Minimum Compressive Strength: As indicated at 28 days.
 3. Maximum w/cm: As indicated on drawings.
 4. Minimum Cementitious Materials Content: 470 lb/cu. yd..
 5. Slump Limit: 4 inches, plus or minus 1.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- C. Class - Interior NW Elevated Slab: Normal-weight concrete used for interior suspended slabs.
1. Exposure Class: ACI 318 As indicated on drawings.
 2. Minimum Compressive Strength: As indicated at 28 days.
 3. Maximum w/cm: As indicated on drawings.
 4. Minimum Cementitious Materials Content: 470 lb/cu. yd..
 5. Slump Limit: 4 inches, plus or minus 1 inch.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- D. Class Walls, Columns, & Piers: Normal-weight concrete used for building walls, columns, and piers.
1. Exposure Class: ACI 318 As indicated on drawings.
 2. Minimum Compressive Strength: As indicated at 28 days.
 3. Maximum w/cm: As indicated on drawings.
 4. Slump Limit: 4 inches, plus or minus 1 inch, or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture.
 5. Air Content:
 - a. Exposure Class F1: 4.5 percent, plus or minus 1.5 percent at point of placement for concrete containing 1-inch nominal maximum aggregate size.
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.10 CONCRETE MIXING

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

- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR BARRIER

- A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barrier in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor barrier with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor barrier over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor barrier at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor barrier manufacturer's instructions.
 7. Protect vapor barrier during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor barrier material, overlapping damages area by 6 inches on all sides, and sealing to vapor barrier.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Place concrete monolithically. Construction Joints may be permitted only after approval of the Engineer.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Division 07 are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor barrier is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor barrier for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor barrier during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Do not place concrete floors and slabs in a checkerboard sequence.
 - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Maintain reinforcement in position on chairs during concrete placement.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 5. Level concrete, cut high areas, and fill low areas.
 - 6. Slope surfaces uniformly to drains where required.
 - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 - 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

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

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated:

- 1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- 2. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1-part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 3. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish:
 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces indicated, to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish:
 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces indicated and to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:

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- 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
- 2) At slabs supporting cells, specified overall values of flatness, F_F 50; and of levelness, F_L 35; with minimum local values of flatness, F_F 40; and of levelness, F_L 24.
- 3) At areas receiving a polished concrete floor finish, specified overall values of flatness, F_F 50; and of levelness, F_L 35; with minimum local values of flatness, F_F 40; and of levelness, F_L 24.

b. Suspended Slabs:

- 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Minimum Compressive Strength: 3500 psi at 28 days.

3. 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.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
5. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 1. Begin curing immediately after finishing concrete.

2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

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- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
 - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

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

h. Terrazzo Floor Areas: At areas to receive terrazzo flooring, cure concrete for a minimum of 28 days. Do not use curing agents in areas to receive terrazzo flooring.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s).

2. Do not fill joints until construction traffic has permanently ceased.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

- 1. Repair and patch defective areas when approved by Architect.
- 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1-part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

- a. Limit cut depth to 3/4 inch.
- b. Make edges of cuts perpendicular to concrete surface.
- c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
- d. Fill and compact with patching mortar before bonding agent has dried.
- e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

- a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
- b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

- 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

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- a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

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3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.

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5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 volumetric method, for structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C567 fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C31:
 - a. Cast and laboratory cure one set of five 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one laboratory-cured specimen at seven days and one set of three specimens at 28 days and hold one specimen for test at 56 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.

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8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, temperature, placement time, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
 2. Diaper hydraulic equipment used over concrete surfaces.
 3. Prohibit vehicles from interior concrete slabs.
 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033100 – SEALED AND POLISHED CONCRETE FLOOR FINISH

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.1 SUMMARY

- A. This Section specifies:
 - 1. Polished concrete finish for interior concrete floor slabs, as identified in the Drawings.
- B. Refer to Division 03 Section "Cast-In-Place Concrete" for additional information.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of grinding machine, (including all types of grinding heads), dust extraction, system, joint filler, concrete densifying impregnator, penetrating sealer, and any other chemicals use in the process.
- B. Design Mixes: For each concrete mix, submit laboratory test reports for concrete materials and mix design test. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Floor surface flatness and levelness measurements to determine compliance with specified tolerances, coordinate with Division 03 Section "Cast-In-Place Concrete".
- D. Samples: For each polished concrete finish indicated, submit 12 inch by 12 inch sample indicating color, finish, reflectivity, and aggregate patterns.

1.3 INFORMATIONAL SUBMITTALS

- A. Applicators qualifications data.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in polishing concrete similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance for at least fifteen (15) years.
 - 1. The concrete polishing applicator must demonstrate to the satisfaction of the Architect, a consistent record of at least 10 (ten) successful concrete polishing projects of equal or greater magnitude over the preceding two (2) years. Submit evidence in writing verifying one of the above required qualifications within forty-eight (48) hours of receipt of bids.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
- C. Manufacturers Certification: Provide a letter of certification from both the equipment and chemical manufacturer stating that the installer is a certified applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.
- D. References: Comply with the following, unless more stringent provisions are indicated:
 - 1. American Concrete Institute (ACI) ACI302.1R-89, "Guide for Concrete Floor and Slab Construction."

2. ASTM C779, "Standard Test Method for Abrasion of Horizontal Concrete Surfaces."
 3. ASTM C805, "Impact Strength."
 4. ASTM G23-81, "Ultraviolet Light & Water Spray."
 5. ASTM 1028, "Coefficient of Friction."
 6. ASTM C150, Type I, II Portland Cement Conformity, depending on soil conditions.
 7. ASTM C33, "Aggregate Conformity."
 8. Slip-Resistance: National Floor Safety Institute (NFSI), NFSI 101-A, Voices of Safety International (VOSI) V41.21, or other standard recognized by officials having jurisdiction.
 - a. Slip-Resistance: Dry and wet (water) testing obtains a minimum SCOF of 0.60 dry and 0.50 wet.
- E. Mockups: Polished concrete panels to demonstrate color, surface finish, texture, tolerances, aggregate patterns, and standard of workmanship.
1. General Contractor to notify applicator a minimum of seven (7) days prior to the concrete pour to schedule finish for mockup.
 2. Reserve 100 square feet for each color and finish at a location adjacent to the floor that will receive polish but will be covered with another flooring material. Mockup floor shall be placed on the same day and with the same pour as the floors to receive polish. At Contractor's option, a stand-alone mockup panel may be used instead of adjacent floor location. Stand-alone panel should be at least 12 feet by 12 feet with a level plywood bottom on level ground with unobstructed access around all four (4) sides. Panel must be of the same pour as the floors scheduled to receive polish.
 3. Install mockups to verify selections made under sample submittal and to demonstrate methods and workmanship proposed for the project.
 4. Aggregate selected must be tested to ensure it will accept polish.
 5. Control joints should be included in mockup. Sawing will be performed by the General Contractor, and can begin as soon as the surface is firm enough not to displace any of the aggregate.
 6. Edges should be included in the mockup.
 7. When approved by Architect, the mockup shall remain as a reference for workmanship demonstrated in the finished work.
- F. Preinstallation Conference: Prior to concrete pour, conduct conference at project site to comply with requirements in Division 01 Section "Project Management and Coordination". Review concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, vapor-barrier installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
1. Attendees shall include representatives of the following:
 - a. General Contractor.
 - b. Concrete Supply Company.
 - c. Concrete placer and finisher.
 - d. Concrete polisher.
 - e. Structural Engineer.
 - f. Architect.

1.5 ENVIRONMENTAL LIMITATIONS

- A. Comply with polishing chemical and equipment manufacturer's written instruction for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
- B. Floor Flatness and Levelness:
 - 1. Finished concrete scheduled to be polished shall have a overall Floor Flatness 50 with a local min of 35, and a Floor Levelness rating of at least 30. Coordinate with Division 03 Section "Cast-In-Place Concrete".
 - 2. Finished concrete shall be cured a minimum of thirty (30) days, or such time that equipment can be put on the slab without displacing aggregate.
- C. Polished concrete areas shall be closed to traffic during finish floor application and after application, for amount of time recommended by the manufacturer.

1.6 PROTECTION PRIOR TO POLISHING

- A. General Contractor shall protect areas to receive polished concrete finish at all times during construction to prevent oils, dirt, metal, excessive water and other potentially damaging materials from affecting the finished concrete surface. Protection measures listed below shall begin immediately after the concrete slab is poured:
 - 1. All hydraulic powered equipment shall be diapered to avoid staining of the concrete.
 - 2. All vehicle parking shall be prohibited on the finished slab areas. If necessary to complete the work, drop cloths shall be placed under the vehicles at all times.
 - 3. No pipe cutting machine shall be used on the finished floor slabs.
 - 4. Steel shall not be placed on the finished slabs to avoid rusting.
 - 5. Acids and acidic detergents shall not come in contact with the slab.
 - 6. All painters shall use drop cloths on the concrete. If paint gets on the concrete, it must be immediately removed.
 - 7. All trades will be informed that the slabs must be protected at all times.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
- C. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer, as applicable and is acceptable to the finishing system manufacturer:
 - 1. Lithium Silicate Hardening and Sealing Agent.

2. Joint Fillers.
3. Conditioner and Stain Guard.

2.2 POLISHING MATERIALS

- A. General: Provide materials in conformance with "Source Limitations" article.
- B. Three-phase, 480-volt generator and step down transformer.
- C. Three (3) head, counter-rotating, variable speed floor grinding machine with at least 800 pounds down pressure.
- D. Dust extraction system, pre-separator, and squeegee attachments with a minimum flow rating of 322 cubic feet per minute.
- E. Grinding Heads:
 1. Metal bonded diamonds or resin-bonded, phenolic diamonds as recommended by polishing equipment manufacturer for application.
- F. Hand Grinder with dust extraction attachment and pads.

2.2 LITHIUM HARDENER / SEALING AGENT

- A. Penetrating Lithium Silicate Hardening/Sealing Agent as recommended by the polishing equipment and concrete stain manufacturers, with the following performance properties:
 1. Form: Clear, water-like liquid.
 2. Specific Gravity: 1.10.
 3. pH: 11
 4. Wt/Gal: 9.2 lbs.
 5. Active Content: 14.5 percent.
 6. Total Solids: 14.5 percent.
 7. Freeze Point: 32 degrees F (0 degrees C)
 8. VOC Content: less than 20 g/L California CHPS.

2.3 JOINT FILLER

- A. Control Joint and Saw Cut Filler: Pumped polyurea with the following properties:
 1. VOC Content: 0
 2. Solids Content: 100 percent.
 3. Gel Time: less than a minute.
 4. Tack free: 2-3 minutes.
 5. Tensile Strength: 600-1200 psi.
 6. Tensile Elongation: 240-500 percent.
 7. Modulus of Elasticity: 400-900 psi.
 8. Adhesion to Concrete: 300-450 psi.
 9. Tear Strength: 150-300 lb/in.
 10. Filler shall be installed between metal cuts.

2.4 CONDITIONER AND STAIN GUARD

- A. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces. Breathable treatment shall permit vapor transmission through concrete.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "RetroPlate RetroGuard" or equivalent product by one of the following:
 - a. Bomanite Corporation; "Stain Guard."
 - b. L&M Construction Chemicals, Inc.; "FGS Concrete Conditioner."
 - c. L. M. Scofield Co.; "Formula One" Finish Coat.
- B. Related Materials:
 - 1. Neutralizing Agent: Tri-sodium Phosphate or Baking Soda.
 - 2. Water: Potable.

2.5 ACCESSORY MATERIALS

- A. Polymer Slip-Resistant Additive: Finely ground polymer for slip resistance, mixed directly into sealer per manufacturer's requirements. Provide companion product by manufacturer of sealing compound, or product acceptable to sealer manufacturer, with written letter of approval.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Slip-Stop.
 - b. The Eulid Chemical Company; Euco Grip.
 - c. Meadows, W.R.; SURE-STEP.
 - 2. Location: Provide slip-resistant additive to sealer at locations noted in Finish Schedule.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Installer shall examine concrete substrate for conditions affecting performance of the finish. Conditions found to be out of compliance with requirements shall be reported to the General Contractor in writing, and the General Contractor shall be responsible for correcting conditions. Repairs are not acceptable unless specifically approve in writing by the Architect. Applicator shall not proceed with polishing until all requirements have been met.
- B. Floor shall be clean of materials and debris.
- C. Protect adjacent surfaces as required to prevent damage by the concrete polishing procedure.
- D. Test floor slab for acceptance of polishing application.

3.2 APPLICATION

- A. Polish: Match mockup reference sample to satisfaction of Architect.
 - 1. Level of finish: Level 2; at a distance of 30 to 50 feet, the floor will clearly reflect from side and overhead lighting.
 - 2. Aggregate Exposure: Salt and Pepper.

- B. Surface Continuity: Perform polished finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of polishing to match design reference sample or mockup.
 - 1. Polish all surfaces that will remain exposed following completion of construction. Where required, use hand polishing tools to polish edges, and corners.
 - 2. Hand- polish all edges to match field floor.
- B. Apply penetrating concrete floor treatment (sealer/hardener) in accordance with manufacturer's instructions.
- C. Polish to pre-determined level based on test sample.
- D. Polish to within 1/2-inch of vertical surfaces.
- E. Properly dispose of collected dry dust from polishing.

3.3 REPAIRS, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 - 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
 - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033100

**SECTION 034500
PRECAST ARCHITECTURAL CONCRETE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- F. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
- G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- H. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- J. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
- K. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.
- L. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
- N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- P. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
- Q. PCI MNL-120 - PCI Design Handbook.
- R. PCI MNL-122 - Architectural Precast Concrete: Fully Revised Manual Including New Sections, Extensive Updates, and Detailed Specifications to Meet Today's Construction Needs..
- S. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete.
- T. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.

- C. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent materials. Provide erection drawings.
 - 1. Include special details and shapes such as building corners, window sills, keystones, and others as applicable.
 - 2. Include joint and reveal sizes, materials, and styles.
 - 3. Include details of mix designs.
 - 4. Include structural design calculations.
- D. Samples: Provide manufacturer's standard size samples illustrating surface finish, color, and texture.
- E. Test Reports: Submit test reports by an independent testing agency, for concrete materials, reinforcing, admixtures, and water-absorption testing.
 - 1. When approved by Architect, in lieu of test reports, fabricator may submit signed certificates in writing indicating material compliance with requirements.
- F. Designer's Qualification Statement.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.04 QUALITY ASSURANCE

- A. Design Engineer Qualifications: Design precast concrete units, including concrete mixes, reinforcement, anchorages, and supports, under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: Comply with at least one of the following:
 - 1. Plant certified under Precast/Prestressed Concrete Institute Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
 - 2. Plant certified under Architectural Precast Association Plant Certification Program for production of architectural precast concrete.
- C. Installer Qualifications: Company specializing in performing installation work for architectural precast, including overhead applications; specifically trained or certified by fabricator for installation of architectural precast products.
- D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- E. Quality Standards: Comply with requirements of the following publications:
 - 1. PCI MNL-120 "PCI Design Handbook - Precast and Prestressed Concrete" for design and fabrication requirements.
 - 2. PCI MNL-117 "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products" for material, forming, testing, finish, and other quality control requirements.
 - 3. PCI MNL-135 "Tolerance Manual for Precast and Prestressed Concrete Construction" for manufacturing, fabrication, and installation tolerances.

1.05 MOCK-UP

- A. See Section 014000 - Quality Requirements for additional requirements.
 - B. Integrated Exterior Mockup: Attend preinstallation conference and provide precast work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."
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1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handling: Lift and support precast units only from support points.
- B. Protect units to prevent staining, chipping, or spalling of concrete.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Architectural Precast Concrete Fabricators:
 - 1. American Stone Virginia, LLC; Ladysmith, VA.
 - 2. Arban Precast, Ltd.; Dumfries, VA.
 - 3. Cast Stone Systems, Inc.; Warrenton, NC.
 - 4. Gate Precast Company; Oxford, NC.
 - 5. Metromont Corp.; Richmond, VA/Charlotte, NC/Greenville, SC.
 - 6. Seaboard Concrete Products Co.; Richmond VA.
 - 7. Southern Castings, Inc.; Valdosta, GA.
 - 8. Smith Midland; Midland, VA.
 - 9. Tindall Corp.; Petersburg VA/Spartanburg, SC.
 - 10. Substitutions: See Section 016000 - Product Requirements.

2.02 PRECAST UNITS, GENERAL

- A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.
 - 1. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
 - 2. Calculate structural properties of units in accordance with ACI 318.
 - 3. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - 4. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.
- B. Sustainability: Coordinate with Division 01 Section "Sustainable Design Requirements." Provide reports and/or mix designs indicating amount of Portland cement replaced by fly ash, silica fume or other recycled waste material.
 - 1. Provide information indicating amount of recycled content in steel reinforcing, anchors, inserts, and other metal components.
- C. Finish Type: Provide a light sandblast or acid etch finish for a smooth surface texture.
 - 1. Color: Shall be selected from manufacturer's full range.

2.03 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).

2.04 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Other Cementitious Materials:
 - 1. Fly Ash or Natural Pozzolans: Comply with ASTM C618.
- C. Fine and Coarse Structural Aggregates: ASTM C33/C33M.

- D. Lightweight Structural Aggregate: ASTM C330/C330M.
- E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
- F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
- G. Air Entrainment Admixture: ASTM C260/C260M.

2.05 MORTAR

- A. Mortar and Mortar Mix: Comply with Division 04 Section "Unit Masonry" for mortar materials and mixes.

2.06 SUPPORT DEVICES

- A. Connecting and Support Devices; Anchors and Inserts: ASTM A36/A36M steel; hot-dip galvanized in accordance with ASTM A153/A153M.
 - 1. Clean surfaces of rust, scale, grease, and foreign matter.
 - 2. Galvanize after fabrication in accordance with requirements of ASTM A123/A123M.
- B. Bolts, Nuts, and Washers: ASTM A307 heavy hex bolts, Type A, hot-dip galvanized, with matching ASTM A563/A563M nuts and matching washers.
- C. Primer: Zinc rich type.

2.07 FABRICATION

- A. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.
- B. Maintain plant records and quality control program during production of precast units. Make records available upon request.
- C. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.
- D. Use form liners in accordance with manufacturer's instructions.
- E. Maintain consistent quality during manufacture.
- F. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.
- G. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.
- H. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- I. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

2.08 FABRICATION TOLERANCES

- A. Comply with PCI MNL-117 and PCI MNL-135, except as specifically amended below.
 - 1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 in.
 - 2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
 - 3. Maximum Variation from Thickness: Plus or minus 1/8 in.
 - 4. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch.
 - 5. Maximum Bowing of Members: Plus or minus length/360.

2.09 SOURCE QUALITY CONTROL

- A. Provide testing and analysis of concrete mix. Testing and analysis may be performed by qualified plant personnel or by third party testing agency.
- B. Take concrete test cylinders as required to test for compressive strength, water-cement ratio, and other performance requirements indicated.
- C. Take air entrainment test cylinder for each set of exterior concrete test cylinders taken.
- D. Take water absorption test in accordance with PCI MNL-117.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 PREPARATION

- A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.03 ERECTION

- A. Erect units without damage to shape or finish. Replace or repair damaged panels.
- B. Erect units level and plumb within allowable tolerances.
- C. Align and maintain uniform horizontal and vertical joints as erection progresses.
- D. Mechanical Fastening: Secure overhead units (such as lintels), copings, large precast panels, and other precast elements, as determined by fabricator's engineer, with mechanical connections or by welding of cast in anchors/studs to supporting structure, in accordance with fabricator's approved erection drawings.
- E. Precast Laid in Mortar: Provide full bed joint at sills, water tables, and similar precast elements. Rake bed joint back for pointing mortar, and point joint slightly concave. Coordinate with flashings, weeps, and other cavity wall materials.
- F. Joints Between Precast Pieces or Between Precast and Other Materials:
 - 1. Provide sealant head joints where precast is exposed horizontally or protrudes from wall surface (for example, at all copings, sills, water tables, and similar shapes).
 - 2. Provide sealant joints at expansion and control joints, above shelf angles or other pressure-relieving joints, and at other building joints.
 - 3. Where precast is completely flush to adjacent wall surface (precast accent course without protruding from wall surface), all head and bed joints may be pointed with mortar.
 - 4. Prime precast before installation of sealant, as required by manufacturer for proper adhesion.
 - 5. Provide compressible filler/backer rod and sealant per Division 7 Section "Joint Sealants."
 - 6. Tool all precast joints (mortar and sealant) slightly concave.
- G. Exposed Joint Dimension: 1/2 inch. Adjust units so that joint dimensions are within tolerances.

3.04 TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135.

3.05 REPAIR AND CLEANING

- A. Repair precast that is damaged during construction to create a uniform match to adjacent precast. If repair is unable to match to the satisfaction of the Owner, remove and replace the damaged piece of precast.
- B. Clean precast of soil, mortar, and other stains or markings.

3.06 PROTECTION

- A. Protect installed precast concrete from subsequent construction operations.

END OF SECTION 034500

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ACI SP-66 - ACI Detailing Manual.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- F. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- H. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- J. ASTM C55 - Standard Specification for Concrete Building Brick.
- K. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
- L. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- M. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- N. ASTM C91/C91M - Standard Specification for Masonry Cement.
- O. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- P. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- Q. ASTM C151 - Standard Test Method for Autoclave Expansion of Hydraulic Cement.
- R. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- S. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- T. ASTM C331/C331M - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- U. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- V. ASTM C476 - Standard Specification for Grout for Masonry.
- W. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- X. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Y. ASTM C641 - Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates.

- Z. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- AA. ASTM C887 - Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar.
- BB. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.
- CC. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.
- DD. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
- EE. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
- FF. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- GG. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- HH. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.
- II. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.
- JJ. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls.
- KK. BIA Technical Notes No. 20 - Cleaning Brickwork.
- LL. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.
- MM. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.
- NN. NCMA TEK 08-04A - Cleaning Concrete Masonry.
- OO. NCMA TEK 12-01B - Anchors and Ties for Masonry.
- PP. NCMA TEK 12-02B - Joint Reinforcement for Concrete Masonry.
- QQ. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section; require attendance by all relevant installers.

1.03 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories, for each type of masonry.
 - 1. Provide elevations indicating steel reinforcing bar locations; provide details of reinforcing including bends and cross-sections, in accordance with ACI SP-66.
 - 2. Indicate control and expansion joint locations.
 - 3. Provide flashing details indicating corners, end dams, and other special conditions.
- C. Samples: Face brick and mortar selections will be verified in mock-up panel. Provide samples of exposed accessories and trim requiring color selection.
- D. Material Certificates and Test Reports: Provide manufacturer's certificates and test reports for the following:
 - 1. Masonry Units:
 - a. Brick: Size data including fabrication tolerances.

- b. Brick: Efflorescence test, per ASTM C67/C67M.
 - c. Masonry Units: Compressive strength test data.
 - d. Concrete Masonry: Data indicating aggregates comply with ASTM C33/C33M (normal weight), ASTM C331/C331M (lightweight), and ASTM C618 (fly ash).
- 2. Mortar and Grout Mixes: Provide description and proportion of materials for each type of mortar and grout.
 - 3. Provide material certificates for each type of metal accessory, including reinforcing bars, joint reinforcement, veneer ties and anchors, and other indicated accessories, indicating compliance with requirements.
- E. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530.1/ASCE 6/TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Fire Rated Assemblies: Provide products that comply with fire-resistance ratings indicated as determined by testing according to ASTM E119, by equivalent testing thickness, or by means acceptable to authorities having jurisdiction.
- C. Source Limitations for Masonry: Provide each type of masonry unit from a single manufacturer's plant, sourced through a single supplier. Each type of masonry unit shall maintain consistency of color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.
 - 1. Source Limitations for Decorative Concrete Masonry: Provide decorative concrete veneers from a manufacturer with a quality control agreement with water repellant manufacturer, certifying that units have been manufactured with integral water repellant to conform to performance requirements indicated. Provide current certificate from water repellant manufacturer confirming conformance.
- D. Source Limitations for Mortar: Provide each mortar mix from a single manufacturer, sourced through a single supplier. Each required mortar mix shall maintain consistency of each component, including cementitious materials and aggregate, to provide consistent color and texture for all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.
- E. Aggregate for Concrete Masonry Units: If bottom ash is used as aggregate in the CMU, the Source for the bottom ash shall be a power station that has a minimum of ten (10) years continuous experience as a supplier of quality material as verified by independent certified laboratory testing and no defects in the marketplace.
- F. Pre-Construction Testing: Owner shall engage an independent testing agency to perform field quality control tests, in accordance with Section 014000 - Quality Requirements.
 - 1. Clay Masonry Unit Tests: Testing agency shall test each variety of clay masonry in accordance with ASTM C67/C67M compressive strength requirements.
 - 2. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry in accordance with ASTM C140/C140M compressive strength requirements.

1.05 MOCK-UPS

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Integrated Exterior Mockups: Attend preinstallation conference and provide masonry work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 FIELD CONDITIONS

- A. Wall Cavity Protection: Provide temporary waterproof sheet coverings over masonry walls at top of walls, sills, parapets, and other horizontal projections. Install coverings at end of each workday, when rain or precipitation is expected, and after masonry work is completed.
 - 1. Extend coverings down vertically at least 24 inches on each side of masonry wall. At multi-wythe walls where one wythe is more than 24 inches taller than other wythe(s), extend covering as required to fully cover all wythes and cavities.
 - a. At roof parapets, extend covering on rear side of parapet full height down to roof deck/membrane, until vertical protection/roof membrane is installed.
 - 2. Secure all coverings in place with tape or adhesive that does not leave residue, or other securement method that does not penetrate or damage permanent construction.
 - 3. Provide protective coverings at sills and horizontal projections that can also serve as protection from mortar droppings.
 - 4. Provide protective coverings over tops of foundation walls containing insulation to protect from exposure to sun and from construction traffic damage.
 - 5. Do not remove or allow removal of temporary covers until permanent top of wall protection elements (coping, sill, roof surface, waterproof membrane, etc) are underway.
- B. Cold- and Hot-Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, headers, other detailed conditions, and as indicated below.
 - a. Provide bullnose units for outside corners.
 - b. Provide solid block with bullnosed top edges at free-standing CMU walls and where top of block is exposed at window sills and similar applications.
 - 3. Concrete Masonry Units: ASTM C90, lightweight.
 - a. Exposed Faces: Manufacturer's standard color and texture.
 - b. Aggregates:
 - 1) Lightweight Aggregates: Lightweight aggregate shall strictly comply with ASTM C331/C331M, ASTM C151, and ASTM C641. Drying shrinkage of aggregate shall not exceed 0.10% at 100 days.
 - 2) Waste concrete, scoria, and aglite shall not be permitted.
 - 4. Decorative Concrete Block: ASTM C90, normal weight.
 - a. Pattern: Manufacturer's standard split-face pattern.
 - b. Size: Match standard nominal dimensions per "Concrete Block" paragraph above.
 - c. Color: To be selected by Architect from manufacturer's full range.

- d. Provide integral water repellent and companion mortar additive at all exterior decorative CMU.
- e. Topcoat: Where recommended by manufacturer of decorative units, provide clear acrylic top-coat, minimum 20 percent solids content.
- 5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Performance of Units with Integral Water Repellent:
 - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - b. Use only in combination with mortar that also has integral water repellent admixture.
 - c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
 - d. Available Products:
 - 1) ACM Chemistries; RainBloc.
 - 2) BASF Aktiengesellschaft; Rheopel Plus.
 - 3) Grace Construction Products (W.R. Grace & Co.); Dry-Block.
- B. Concrete Brick:
 - 1. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 2. Concrete Building Brick: ASTM C55; lightweight, solid, for interior or concealed use.

2.02 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS or FBX, Grade SW.
 - 1. Actual Size: 3-5/8 inches wide by 3-5/8 inches high by 7-5/8 inches long (economy).
 - 2. Special Shapes: Molded units (plant-fabricated) as required by conditions indicated, unless standard units can be sawn to produce equivalent effect. Cut or sawn edges shall not be exposed in the finished work.
 - 3. Efflorescence: Provide brick that has been tested per ASTM C67/C67M and received a rating of "not effloresced."
- B. Building (Common) Brick: ASTM C62, Grade SW, except MW may be used in locations indicated acceptable in reference standard; solid units.
 - 1. Actual size: Match face brick.
 - 2. Locations: May be used in concealed locations in lieu of face brick.

2.03 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
 - 1. Colored Mortar: Premixed cement as required to match Architect's color sample.
 - 2. Available Products:
 - a. Argos USA; Magnolia Masonry Cement.
 - b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - c. Lehigh Hanson; flamingo Colored Cement.

- d. Roanoke Cement; a division of Titan America; Colored Masonry Cement.
- e. York Building Products, a Stewart Company; Workrite Colored Masonry Cement.
- B. Surface Bonding Mortar (Parge Coat): ASTM C887.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Water: Clean and potable.
- F. Accelerating Admixture: ASTM C494/C494M, Type C; nonchloride, noncorrosive type for use in cold weather; approved by manufacturer for use in masonry mortar.
- G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
 - 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.04 DAMPPROOFING

- A. General: Dampproofing may be provided as a Contractor option to parge coat, applied to exterior face of below grade CMU back up wall (prior to insulation or grouting).
- B. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
 - 1. Emulsified Asphalt Coating (Brush or Spray Applied): ASTM D1227/D1227M, Type II, Class 1 - Mineral colloid emulsifying agents with non-asbestos fibers or Type III, Class 1 - Mineral colloid emulsifying agents without fibrous reinforcement.
 - 2. Accessory Materials: Provide asphaltic primer, glass fiber reinforcement, and compatible patching compounds as required and as recommended by manufacturer.
 - 3. Manufacturers:
 - a. Henry Company.
 - b. Karnak Corporation.
 - c. Mar-Flex Systems, Inc.
 - d. W. R. Meadows, Inc.
 - e. Substitutions: See Section 016000 - Product Requirements.

2.05 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.
- B. Joint Reinforcement, Anchorage, and Ties, General: Comply with NCMA TEK 12-02B, NCMA TEK 12-01B, and requirements below.
 - 1. Use ladder type joint reinforcement, unless otherwise indicated. Truss type reinforcement may be used only when approved by Architect, at walls indicated not to have vertical reinforcing steel and not to be grouted.
 - 2. Provide prefabricated joint reinforcement sections for corners and for T-intersections.
 - 3. Provide joint reinforcement in minimum 10 foot lengths.
 - 4. At multi-wythe/cavity wall applications, size all anchors, ties, and reinforcement for depths of cavities indicated, including indicated insulation thickness as applicable. Ties shall maintain full adjustability at veneer wythe without affecting insulation.

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5. At cavities with air space wider than 4-1/2 inches, provide high strength ties engineered for cavity depths indicated.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 1. Material: Mill-galvanized steel for interior walls, hot-dip galvanized steel for exterior walls.
 2. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- D. Multiple Wythe Joint Reinforcement: ASTM A951/A951M. Provide at composite walls and subgrade walls where all wythes are of the same material.
 1. Material: Mill-galvanized steel for interior walls, hot-dip galvanized steel for exterior walls.
 2. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
 - a. Provide two side rods for each wythe that is nominal 6-inch depth or greater, and one side rod for each wythe that is nominal 4-inch depth.
- E. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M. Provide at cavity walls/masonry veneer walls.
 1. Type: Ladder, with adjustable ties or tabs spaced at 16 in on center.
 2. Material: Hot-dip galvanized steel.
 3. Size: 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire, width of components as required to extend at least halfway through veneer wythe, but provide not less than 5/8 inch of mortar coverage from each masonry face.
 4. Vertical adjustment: Not more than 1 1/4 inches.
- F. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
- G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 1. For Anchorage to Structural Steel Framing: Crimped wire anchors for welding to frame, 0.25 inch thick, with triangular/trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- H. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B. Provide at masonry veneer walls with metal framing backup. At cavity walls with CMU backup and masonry veneer, masonry veneer anchors may be used in conjunction with standard horizontal joint reinforcing, at Contractor's option, in lieu of adjustable multiple wythe joint reinforcement.
 1. Anchor Plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 2. Wire Ties: Manufacturer's standard shape, 0.1875 inch thick.
 - a. Size wire ties to extend at least halfway through veneer wythe, but provide not less than 5/8 inch of mortar coverage from masonry face.
 3. Vertical Adjustment: Not less than 3-1/2 inches.
- I. Metal-to-Metal Fasteners (for Steel Studs): Self-drilling, self-tapping #10 hex screws; fabricated of either 304 stainless steel or of steel with corrosion resistant polymer coating tested to ASTM B117. Fasteners shall include integral neoprene or EPDM washer.
 1. Manufacturers:
 - a. ELCO Construction Products; Dril-Flex with Stalgard Finish.
 - b. Heckmann Building Products; #668 TEK Self-Drilling Steel Stud Screw.

- c. ITW Commercial Construction North America; Teks Maxiseal with Climaseal Finish, or Scots Long Life Teks (stainless steel).

2.06 FLASHINGS

- A. Combination Nonasphaltic Flashing Materials - Copper:
 - 1. Copper/Polymer Film or Fabric Flashing: 5 oz/sq ft copper sheet laminated between two sheets of polymer film. Minimum Puncture Resistance of 780 psi, when measured in accordance with ASTM E154/E154M.
 - a. Available Products:
 - 1) Advanced Building Products, Inc.; Copper Sealtite 2000.
 - 2) Hohmann & Barnard, Inc; Copper-Fabric NA.
 - 3) STS Coatings, Inc.; Wall Guardian Copper TWF.
 - 4) York Manufacturing, Inc; Multi-Flash 500 Series.
- B. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
 - 1. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
 - a. Manufacturers:
 - 1) Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing.
 - 2) Prosoco; R-Guard SS ThruWall.
 - 3) STS Coatings; Wall Guardian Stainless Steel TWF.
 - 4) York Manufacturing, Inc; Multi-Flash SS.
- C. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.
- D. Termination Bars: One-inch wide, fabricated of 0.125-inch PVC, 0.090-inch extruded aluminum, or 0.075-inch stainless steel; compatible with membrane and adhesives.
- E. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
- F. Flashing Sealant/Adhesive/Liquid Seam Tape: Polyether-based, 100% solids, moisture-curing elastomeric products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates; and that are compatible with asphalt-free flashing materials and air barrier materials. Traditional mastic is not acceptable.
 - 1. Available Products:
 - a. Master Builders Solutions; MasterSeal NP150.
 - b. STS Coatings; GreatSeal LT-100 Liquid Tape.
 - c. York; UniverSeal US-100 Liquid Tape.

2.07 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Provide nominal 2.5-inch "standard" and "tee" configurations to suit application unless indicated otherwise.
 - B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
 - C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations. Provide in depth matching cavity depth without gap at front or back of mesh. Fabricate approximately
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10 inches high with minimum 6 inch high dovetail shape projections.

- a. Available Products:
 - 1) Advanced Building Products, Inc; Mortar Break DT.
 - 2) Heckmann Building Products; WallDefender.
 - 3) Hohmann & Barnard, Inc.; Mortar Trap.
 - 4) Mortar Net Solutions; MortarNet.
 - 5) Wire-Bond; Cavity Net DT (3611D).
 - b. At cavities with depth greater than 2 inches, provide companion drainage product by one of the manufacturers above; nominal 1/2-inch thickness by 20 inches wide, to be field inserted into cavity in a "U" configuration. Basis-of-Design is "Mortar Catch 352" by Advanced Building Products, Inc.
- D. Bond Break: ASTM D226/D226M, Type I ("No.15") asphalt felt or polyethylene tape.
- E. Weeps/Cavity Vents:
- 1. Cellular Type: Extruded propylene with honeycomb design.
 - a. Color(s): Clear.
 - b. Available Products:
 - 1) Advanced Building Products, Inc.; Mortar Break weep mesh.
 - 2) Blok-Lok Limited; Cell-Vent.
 - 3) CavClear/Archovations, Inc.; CavClear Weep Vent.
 - 4) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 5) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 6) Mortar Net Solutions; WeepVent.
 - 7) Wire-Bond; Cell Vent.
 - 2. Bed Joint Weep System: Corrugated plastic drainage system incorporating continuous drainage strip within cavity portion of wall with integral weephole extensions at 9-1/2 inches on center located above flashing in the bed joint of the veneer masonry. Provide at masonry units over 32 inches long, and as indicated.
 - a. Available Products:
 - 1) Heckmann Building Products; Core/Cavity Vent Weep System #367.
 - 2) Masonry Technology Incorporated (MTI); Cavity Weep CV 5010.
- F. Reinforcing Positioners: Provide wire positioners in bed joints to keep steel reinforcing bars centered in cells, fabricated of 0.1483-inch hot-dip galvanized steel wire.
- 1. Available Products:
 - a. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.
 - b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.08 LINTELS

- A. Masonry Lintels: Fabricated of bond beam CMUs, with texture matching adjacent standard CMU. Provide reinforcing bars and grout in accordance with structural requirements. Provide temporary supports until cured.
 - B. Precast Concrete Lintels: Comply with structural requirements for concrete strength and reinforcing. Precast U-lintels fabricated in accordance with performance standards of PCI MNL-116 with 3500 psi concrete for standard lintels and 6000 psi concrete for prestressed lintels as manufactured by Cast-Crete are acceptable in lieu of rectangular section lintels.
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- C. Steel Lintels: Refer to Section 055000 - Metal Fabrications.

2.09 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
 2. Reinforced masonry: Type S.
 3. Mortar parge coats: Type S.
 4. Exterior, loadbearing and non-loadbearing, and interior, loadbearing and non-loadbearing: Type N, except as indicated above.
 - a. Interior, non-loadbearing masonry may use Type O at Contractor's option.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
1. Use colored mortar for all veneer masonry. Separate colors shall be required for each type and color of veneer.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. For installation in cold or hot weather, comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
1. CMU Coursing: One unit and one mortar joint equal 8 inches.
 2. Brick Coursing: Either two or three units with accompanying mortar joints shall equal 8 inches, based on basis-of-design brick size(s) indicated above.
- C. Provide running bond for all masonry units unless otherwise indicated.
- D. Tool all mortar joints slightly concave where they will be exposed, unless otherwise indicated.

1. Provide flush joints where they will be concealed by surface-applied treatments or finishes other than paint; including but not limited to tile, wall coverings, fluid-applied or SPF air barriers, or membranes.

3.05 PLACING AND BONDING

- A. Remove broken, cracked, chipped, or otherwise damaged masonry units from pallets and set aside. Do not use unless they may be field cut to remove damaged section, for installation where special shape is required to fit construction.
- B. Create a consistent blend for each type of veneer masonry by mixing units from a minimum of three pallets.
- C. Provide asphalt felt or polyethylene tape bond-breaker between clay masonry and concrete or other masonry types. Rake back joints for sealant.
- D. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- E. Lay hollow masonry units with face shell bedding on head and bed joints.
- F. Remove excess mortar and mortar smears as work progresses.
- G. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 1. Do not cut masonry unless it is required for certain shapes, such as rowlock sills, or unless it is unavoidable due to fitting around other construction, such as wall penetrations.
 2. Cut masonry edges shall not be visible in the final work. Where special shapes are required that would expose cut edges, they shall be plant-fabricated.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHER MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. At parapets and below-grade/foundations, provide joint reinforcement at 8 inches o.c. vertically.

- E. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- F. Lap joint reinforcement ends minimum 6 inches.
- G. Do not extend reinforcement across control, expansion, and other building movement joints.
- H. Reinforce corners and intersections with prefabricated T- or L-shaped reinforcing.
- I. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.
- J. Embed ties and anchors in mortar joint and extend at least halfway through masonry veneer unit; with at least 5/8 inch mortar cover to the outside face of the anchor.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry and/or Metal Framing Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.10 REINFORCEMENT AND ANCHORAGES - COMPOSITE UNIT MASONRY

- A. Install continuous horizontal joint reinforcement at 16 inches o.c. vertically, except at below grade foundation walls install at 8 inches o.c. vertically.
- B. Where concrete foundations are indicated, tie below-grade masonry to concrete with rigid anchors spaced at maximum 8 inches o.c. vertically.
- C. Coordinate with parging/dampproofing and with installation of insulation, where indicated.

3.11 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 2. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 16 inches minimum on vertical surface of backing:
 - 1. Anchor vertical leg of flashing into backing with a termination bar and sealant.
- C. Extend metal flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
 - 1. Notch and hem exterior corners of drip edges to eliminate sharp, exposed cut metal edges at locations below 6' - 0" above grade.
- D. Support flexible flashings across gaps and openings.
- E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.12 LINTELS

- A. Comply with requirements on Structural Drawings for type of lintel at each opening, additional lintel sizing, reinforcement, and installation requirements.
- B. Install loose steel or precast lintels over openings, where indicated.
- C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Allow masonry lintels to attain specified strength before removing temporary supports.

- D. Maintain minimum 8 inch bearing on each side of opening, unless otherwise indicated.

3.13 GROUTED COMPONENTS

- A. Comply with requirements on Structural Drawings for locations of structural grouted components and accessories, including but not limited to, grouted bond beams, reinforced unit masonry walls, (including locations and sizing of vertical steel bar reinforcing), grouted solid CMU, and composite wall collar joints.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.

3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Provide control and expansion joints at locations indicated on Drawings, and as follows:
 - 1. At changes in wall height.
 - 2. At changes in wall thickness
 - 3. At change in support (eg: transition from foundation support to floor slab support).
 - 4. Adjacent to corners of walls within a distance equal to no more than half the maximum control joint spacing.
 - 5. Wall intersections.
 - 6. Do not place control joints closer than 16 inches to edge of wall openings (doors, windows, louvers, ducts).
 - 7. Distance between joints shall not exceed a length to height ratio of 1.5:1.
 - 8. Distance between joints shall not exceed 25 feet where no openings occur between joints.
 - 9. Distance between joints shall not exceed 20 feet where openings occur between joints.

3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, anchor bolts, and plates and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Mix mortar (or grout) to a 4-inch maximum slump consistency and hand trowel into place in accordance with Steel Door Institute (SDI-100).
 - 2. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.16 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.17 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and other penetrations. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 PARGING

- A. Dampen masonry walls prior to parging.
- B. Parge cavity side of CMU below grade back-up wythe with a single coat of surface-bonding mortar to a total thickness of 1/4 inch.
 - 1. In lieu of parging, Contractor may at its option apply bituminous dampproofing, at a minimum rate of 1.25 gal per 100 sq. ft. Apply primer if required by manufacturer and comply with manufacturer's installation requirements.
- C. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.
- D. Strike top edge of parging at 45 degrees.

3.19 FIELD QUALITY CONTROL

- A. Field Inspection: The Owner shall engage an independent inspection agency to perform field quality control inspections and prepare field reports.
 - 1. The Contractor shall permit full access to inspectors in order to perform inspections, including use of temporary facilities and equipment such as scaffolding or lifts.
 - 2. Do not enclose cavities or spaces to be grouted solid until inspections have approved grout and reinforcement for material properties, size, and installation locations.
- B. Field Testing: The Owner shall engage an independent testing agency to perform field quality control tests, as specified in Section 014000 - Quality Requirements. For each type of masonry unit, 5 randomly chosen units shall be sampled for each 5,000 square feet of wall.
 - 1. Clay Masonry Unit Tests: Testing agency shall test each variety of clay masonry in accordance with ASTM C67/C67M requirements.
 - 2. Concrete Masonry Unit Tests: Testing agency shall test each variety of concrete unit masonry, of each load-bearing size indicated, in accordance with ASTM C140/C140M requirements.
 - 3. Mortar Tests: Testing agency shall test each type of mortar in accordance with ASTM C780. Mortar shall be tested on each of the first 3 days. Alert testing agency if mortar mix is altered during construction to allow for retesting.
 - 4. Grout Test: Testing agency shall test each type of grout in accordance with ASTM C1019. Grout shall be tested on each of the first 3 days. Alert testing agency if grout mix is altered during construction to allow for retesting.

3.20 REPAIR AND CLEANING

- A. Remove masonry units that have become damaged or stained, or that do not display acceptable blend of color and texture matching mockup/sample panel. Remove as whole units, do not cut. Replace with new units with fresh mortar joints.
- B. Remove excess mortar and mortar droppings.

- C. Replace defective mortar and repoint. Enlarge holes or voids at defective mortar, and remove enough adjacent mortar to allow for repointing. Install fresh mortar joint and match to adjacent work.
- D. Where expansion/control joints and sealant joints are indicated, clean joints and leave them clear and ready for installation of joint or sealant materials.
- E. Clean concrete masonry in accordance with NCMA TEK 08-04A and clean clay masonry in accordance with BIA Technical Notes No. 20. Use hand cleaning/bucket-and-brush methods.
- F. To prevent freezing of cleaners and rinse water, do not clean when masonry surface temperature will drop below 40 degrees F.
- G. Test cleaning methods and materials on one half of mockup/sample panel; leave the other half uncleaned. Obtain approval of Architect before cleaning the finished work.
- H. Protect adjacent non-masonry surfaces from cleaning materials and processes with temporary sheeting or masking.
- I. Provide "in-progress" cleaning; clean masonry in each area as soon as possible after mortar has fully cured (approximately 7 to 28 days; coordinate with manufacturer's recommendations for each mortar type specified). Field test a small area to ensure mortar curing is complete prior to large-scale cleaning.
- J. Pre-wet masonry surfaces and clean with specified cleaning solution. Rinse surfaces immediately after cleaning; do not allow cleaning solution to dry or set into the masonry.
- K. Use non-metallic tools in cleaning operations.
- L. Final Cleaning: As part of Project Closeout (prior to Substantial Completion), provide Final Cleaning of masonry veneer. Remove construction dust with a very low pressure rinse. Perform a visual inspection and spot clean to remove efflorescence, staining, or organic growth, in accordance with recommendations of BIA and NCMA technical notes.

3.21 PROTECTION

- A. Provide temporary protective waterproof sheet coverings over tops of walls, parapets, sills, and other horizontal projections as the work progresses, in accordance with FIELD CONDITIONS article in Part 1 above.
- B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- C. Provide protective vertical boards and horizontal sheeting at grade level base of walls to prevent staining or splashing from rain, mud, or mortar droppings.

3.22 MASONRY WASTE

- A. Fill Material: Clean masonry waste may be used as fill material. Break up masonry waste into small pieces no greater than 4 inches any direction. Mix with Division 31 engineered fill material so that masonry waste is no more than 33% of the fill (1 part masonry waste, 2 parts engineered fill). Fill containing masonry waste shall be at least 18 inches below grade level.
 - 1. Excess waste shall be removed and disposed of or recycled in accordance with Division 1 waste disposal requirements.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Structural steel.
- 2. Shear stud connectors.
- 3. Shrinkage-resistant grout.

- B. Related Requirements:

- 1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
- 2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6 with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- C. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- D. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system, and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the project site.

1.6 ACTION SUBMITTALS

A. Product Data:

- 1. Structural-steel materials.
- 2. High-strength, bolt-nut-washer assemblies.
- 3. Shear stud connectors.
- 4. Anchor rods.
- 5. Threaded rods.
- 6. Forged-steel hardware.
- 7. Slide bearings.
- 8. Shop primer.
- 9. Galvanized-steel primer.
- 10. Etching cleaner.
- 11. Galvanized repair paint.
- 12. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

- 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
- 2. Include embedment Drawings.
- 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
- 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
- 5. Identify members and connections of the seismic-load-resisting system.
- 6. Indicate locations and dimensions of protected zones.
- 7. Identify demand-critical welds.
- 8. Identify members not to be shop primed.

- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1.9 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer licensed in the state in which the project is located.
 - a. Use Allowable Stress Design; data are given at service-load level.
- C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes, Angles: ASTM A992.
- B. Channels, M-Shapes, S-Shapes: ASTM A36.
- C. Plate and Bar: ASTM A36.
- D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade C, structural tubing.

- E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
 - 1. Weight Class: Standard, unless otherwise indicated.
 - 2. Finish: Black except where indicated to be galvanized.
- F. Steel Forgings: ASTM A668/A668M.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts or ASTM F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Shear Stud Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade as indicated.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36 carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Plain.

B. Headed Anchor Rods: ASTM F1554, Grade as indicated, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36 carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

C. Threaded Rods: ASTM A36.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Plain.

2.5 PRIMER

A. Steel Primer:

1. Comply with Division 9.
2. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint:

1. Galvanizing Repair Paint: ASTM A780.

2.6 SHRINKAGE-RESISTANT GROUT

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

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: As indicated.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. For Concealed Steel:
 - a. SSPC-SP 2.
 - b. SSPC-SP 3.
 2. "For Exposed Steel:
 - a. SSPC-SP 6 (WAB)/NACE WAB-3."SSPC-SP 10 (WAB)/NACE WAB-2"
Subparagraph below requires that 95 percent of surface area be free of visible residue.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1 for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1 on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: As indicated.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. K-series steel joists.
- 2. KCS-type K-series steel joists.
- 3. Steel joist accessories.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
- 2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.

- B. Shop Drawings:

- 1. Include layout, designation, number, type, location, and spacing of joists.
- 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and professional engineer.

- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
 2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
 3. Provide holes in chord members for connecting and securing other construction to joists.
 4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
 5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
 6. Do not camber joists.
 7. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Primer:
1. Low-Emitting Materials: Paint and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 2. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
 3. Provide shop primer that complies with Division 9.

2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
1. Provide bridging anchors and number of rows of horizontal and/or diagonal bridging of material, size, and type required by SJI's "Specifications for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125 Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
1. Finish: Plain.

- D. Welding Electrodes: Comply with AWS standards.
- E. Galvanizing Repair Paint: ASTM A780.
- F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications, joist manufacturer's written instructions, and requirements in this Section."
 1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Touchup Painting:
 - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Composite floor deck
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Roof deck.
 - 2. Composite floor deck
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- D. Research Reports: For steel deck, from ICC-ES.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its RoofNav for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 40, G60 zinc coating.

2. Galvanized and Shop-Primed Steel Sheet: ASTM A653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
3. Deck Profile: As indicated.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 zinc coating.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated
 4. Span Condition: Triple span or more.

2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter, unless otherwise indicated.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 50,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 50,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- J. Galvanizing Repair Paint: ASTM A780.
- K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

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

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Repair Painting:
 - 1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 9.
 - 4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

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END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING – STRUCTURAL (CFSF-S)

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. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing indicated as CFSF-S.
4. Ceiling joist framing.
5. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 092216 "Cold Formed Steel Framing – Non-Structural (CFSF-NS)" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports:
 - 1. For nonstandard cold-formed steel framing, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- E. Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing – General Provisions."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. AllSteel Products, Inc.
2. Clark Steel Framing.
3. Consolidated Fabricators Corp.; Building Products Division.
4. Craco Metals Manufacturing, LLC.
5. Custom Stud, Inc.
6. Formetal Co, (The).
7. MarinoWare; a division of Ware Industries.
8. SCAFCO Corporation.
9. Southeastern Stud & Components, Inc.
10. Steel Construction Systems.
11. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: As indicated on Drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height. Maximum horizontal deflection of 1/600 of the wall height where supporting brick veneer, GFRC, or architectural precast concrete.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height. Maximum horizontal deflection of 1/600 of the wall height where supporting brick veneer, GFRC, or architectural precast concrete.
 - d. Interior Non-Load-Bearing Framing indicated as CFSF-S: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - e. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

- a. Upward and downward movement of 1-1/2 inches.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 1. Grade: As required by structural performance.
 2. Coating: G60.
- B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: As required by structural performance.
 2. Coating: G60.

2.4 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-5/8 inches.
 3. Depth: as indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.0428 inch.
 2. Flange Width: 1-1/4 inches

- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Top Flange Width: 1-5/8 inches.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
 - 3. Depth: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.

- b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: Outer deflection track flange width plus 1 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
 - 3. Depth: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.

- b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: Outer deflection track flange width plus 1 inch.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.8 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.

2.9 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole-reinforcing plates.
 - 11. Backer plates.

2.10 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 55 weldable (supplement S1), threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Type: Torque-controlled adhesive anchor or adhesive anchor.
 - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.11 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

- F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil nominal thickness, self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
1. Physical Properties:
 - a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
 - b. Low-Temperature Flexibility: Pass at minus 25 deg F ASTM D146/D146M.
 - c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96/E96M, Method B.
 - d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.12 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
1. Fabricate framing assemblies using jigs or templates.
 2. Cut framing members by sawing or shearing; do not torch cut.
 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- C. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

- b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 7 in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, which are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: As shown on Shop Drawings.
- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.
 - 1. Fasten both flanges of studs to top and bottom tracks.
 - 2. Space studs as follows:
 - a. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
 - 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
 - 2. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Do not fasten studs to deflection track. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 - 2. Connect drift clips to cold-formed steel framing and anchor to building structure.

- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Do not fasten studs to deflection track. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to studs and anchor to building structure.
 - 3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 054003
CONTINUOUS INSULATION (CI) FRAMING SYSTEM, CLIPPED

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- F. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- H. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- I. ASTM F594 - Standard Specification for Stainless Steel Nuts.
- J. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric.
- K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Conduct pre-installation meeting at Project site before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
- B. Coordinate with work of other sections that is to be installed over, or anchored to, the continuous insulation (CI) framing system, including but not limited to structural anchors, claddings and cladding anchors, utilities, insulation, and firestopping.

1.03 DEFINITIONS

- A. Clipped Continuous Insulation (CI) Framing System: An engineered "fixing" system of framing designed to support building veneers on metal girts, transmitting all structural loads through insulation to the wall substrate via intermittent, thermally-isolated clips while maintaining required thermal performance of the wall.

1.04 SUBMITTALS

- A. Product Data: Provide product data for factory fabricated continuous insulation (CI) framing members and each accessory product.
- B. Shop Drawings: Indicate component details, including sizes, depths, and thicknesses of clips, girts, rails, and accessories or items required of related work.
 - 1. Indicate cladding joint layout, with CI framing system clip and girt layout and spacing coordinated for proper anchorage and support.

2. Indicate anchorage details including mechanical fasteners for securing CI framing system to primary structural wall element.
 - a. Indicate supplemental framing and reinforcing as required due to structural calculations.
3. Design Data: Include calculations for loadings and stresses of factory fabricated CI framing for project specific claddings and loadings, signed and sealed by a professional structural engineer.
- C. Thermal Modeling Report: Provide test data indicating reduction of R-value of continuous insulation due to framing penetrations. Test data shall demonstrate, at minimum, compliance with ANSI/ASHRAE 90.1 U-factor requirement for walls of construction indicated.
- D. Test Reports: Provide test reports performed by a qualified testing agency, for structural anchors, mechanical fasteners, framing clips, and accessories.
- E. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.
- F. Designer's Qualification Statement.
- G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design CI framing system 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. Installer Qualifications: Company specializing in exterior/envelope wall systems installation, experienced in the erection and installation of CI framing systems with a history of successful in-service use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Prior to installation, store materials and components under cover in a dry, clean location.
- D. Protect CI framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

1.07 WARRANTY

- A. Warranty: Installer's warranty against failures in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion. Failures include structural cracks or punctures, material deterioration, and workmanship.
 1. Warranty Period: Two years beginning at the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Continuous Insulation (CI) Framing Systems:
 1. Aluminum Systems:
 - a. ECO Cladding; Alpha Vci / Hci.
 - b. GIP GmbH; VECO-A.
 - c. Hilti; FOX VI.
 - d. SFS intec Ltd. / NVELOPE Rainscreen Systems Ltd.; NV / NH2.

2. Steel Systems:
 - a. GIP GmbH; VECO-G.
 - b. Knight Wall Systems; MFI D-Series.
3. Substitutions: See Section 016000 - Product Requirements.

2.02 CONTINUOUS INSULATION (CI) FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
 - B. Design Requirements: Provide completed CI framing system, capable of supporting indicated exterior finish cladding(s) in a "rainscreen" design when anchored to indicated structural substrates. System shall consist of thermally isolated brackets supporting vertical girts. Where necessary due to cladding orientation or engineered design, vertical girts shall support horizontal rails. Design shall have the following characteristics:
 1. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
 2. Design Loads: Refer to Structural Drawings for wind and live loads.
 3. Spacing and types of girts and rails shall be as required by cladding manufacturer to support each indicated type of cladding.
 - a. Coordinate with cladding manufacturer(s) for dead loads of cladding system(s).
 - b. Coordinate with indicated joint layouts to ensure secondary girts are spaced to provide appropriate structural attachment for cladding(s).
 4. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 5. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - C. Thermal Performance: System shall obtain effective R-value or U-factor indicated.
 1. Continuous framing profiles fully penetrating insulation are not allowed. Metal framing shall not thermally bridge exterior and interior except for fasteners.
 2. Framing assembly shall not reduce continuous insulation nominal R-value to less than 90% effective R-value.
 3. Continuous insulation framing system shall be thermally modeled to demonstrate, at minimum, compliance with ANSI/ASHRAE 90.1 maximum U-factor for walls.
 - D. Flatness: Installed system and components shall be flat within the tolerances allowable by cladding manufacturer; with no noticeable warping, buckling, deflections, or other surface irregularities that distort cladding.
 - E. Heat Resistance: All components that will come into contact with spray foam insulation shall be capable of exposure to the heat generated by spray foam installation without damage, including plastic washers and thermal spacers. Plastics and resins shall be rated for exposure to temperatures of 300 degrees Fahrenheit or more intermittently without loss of structural capacity or integrity.
 - F. Ventilation: System design shall allow for movement of air in the cavity behind the cladding, including compartmentalization and/or cross-ventilation for a pressure-equalized system where indicated.
 - G. Drainage: System design shall allow for drainage of moisture from the cavity behind the cladding.
 - H. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with Code of Standard Practice.
-

- I. Shop fabricate framing system to the greatest extent possible.
- J. Deliver to project site in largest practical sections.

2.03 CONTINUOUS INSULATION FRAMING MATERIALS

- A. Steel Framing: Either ASTM A792/A792M aluminum-alloy coated steel or ASTM A1046 zinc-aluminum-magnesium alloy coated steel.
- B. Aluminum Framing: ASTM B209/B209M, Alloy 6061-T6 for plate and sheet and ASTM B221, Alloy 6063-T6 for extrusions.
- C. Brackets: To suit girts and cladding system loads, and providing for field adjustment of girts to maintain plane of cladding. Provide fixed or floating type as required to accommodate expansion.
- D. Girts: As required to suit anchoring of perpendicular rails. Provide either vertical or horizontal girts as required due to indicated orientation of cladding.
 - 1. Perpendicular Rails: Subframing rails mounted to girts, to meet the requirements of cladding manufacturer for support and attachment at cladding ends and joints, and for regular spacing for attachment of claddings.

2.04 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Type 304 stainless-steel or zinc-plated with electrodeposition coating per ASTM B633 or ASTM F1941/F1941M.
- B. Anchorage Devices: Drilled expansion bolts or chemical anchors; Alloy Group 1 stainless steel per ASTM F593 for bolts and ASTM F594 for nuts.

2.05 ACCESSORIES

- A. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION

- A. Install components in accordance with manufacturers' instructions.
- B. Attach primary brackets prior to application of spray foam insulation/air barrier. Install brackets true to line with secure connections to primary structural components, at spacing required by load calculations and as indicated on Shop Drawings.
- C. After installation of spray foam insulation/air barrier, remove only amount needed for attachment of secondary girts/rails and cladding support anchors. Notify spray foam installer if amount of material removed affects wall's insulating or air/vapor barrier performance, or if touch up is required.
- D. Install framing girts/rails plumb, square, and true to line, with securely fastened connections.
 - 1. If cutting is required, cut by sawing or shearing, do not torch cut. Protect adjacent surfaces from sparks.
 - 2. Fasten CI framing members by screw fastening. Locate all mechanical fasteners as indicated on Shop Drawings.

3. Locate screws at slotted holes to allow for expansion and contraction in the CI framing system design.
4. Each girt shall be supported by at least two primary support brackets.
5. Do not bridge building expansion joints with CI framing. Independently frame both sides of joints.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/8 inch.
- B. Maximum Variation of any Member from Plane: 1/8 inch, unless otherwise indicated by cladding manufacturer.

3.04 REPAIR AND PROTECTION

- A. Touch up shop-applied coatings as required if damaged during handling or installation.
- B. After installation of primary support brackets, inspect substrates for damage and repair substrate flashings or membranes as required.
- C. Provide fine adjustments to CI framing as required immediately prior to cladding installation to verify that tolerances are maintained. Prepare CI framing in a timely manner to avoid excessive UV exposure to substrate membranes, air barriers, and other materials.
- D. Provide final protection of CI framing as required to ensure that CI framing system is without damage or deterioration prior to installation of cladding.

END OF SECTION 054003

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- H. 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.
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- J. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- L. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.
- M. NAAMM MBG 531 - Metal Bar Grating Manual.
- N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 SUBMITTALS

- A. Product Data: Provide product data for factory fabricated products and accessory materials, including the following:
 - 1. Stair nosings.
 - 2. Nonslip finishes.
 - 3. Nonshrink grout.
 - 4. Shop primer paint products.
 - a. Coordinate with Division 9 Painting topcoat manufacturer and provide compatibility certificates from topcoat manufacturer that shop primers are acceptable substrate for specified topcoats.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Include field measurements, and indicate where field measurements differ from documents.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.03 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- B. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials, General: Provide metal fabrications and components with finished surfaces that are smooth and flat. Metal fabrications and components shall not have labels, stickers, engraved or rolled manufacturer names, seams, or blemishes that are exposed in the finished work.

2.02 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M Grade B cold-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Fittings: ASTM A1011/A1011M.
- F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
 1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.
 2. Provide stainless steel fasteners at areas subject to moisture or steam, including mechanical rooms, janitor/custodial rooms with floor sinks, and similar spaces.
 3. Provide zinc-plated fasteners for interior construction except where stainless steel is indicated.
- G. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, universal shop primer, complying with VOC limitations of authorities having jurisdiction.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.04 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. 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.
- D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.05 FABRICATED ITEMS

- A. Metal Ladders: Refer to Section 055133 - Metal Ladders.
- B. Bollards: Schedule 40 steel pipe, concrete filled, crowned cap, as detailed; nominal 6-inch diameter unless otherwise indicated; prime paint finish.
 - 1. In lieu of field formed crowned cap, Contractor may at its option provide precast, symmetrically domed caps.
- C. Catwalk: Fabricate steel plate and other components specified in Division 05 Section "Structural Steel Framing" for catwalk assembly.
- D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.
- E. Lintels: As detailed; prime paint finish.
- F. Door Frames for Overhead Door Openings and Wall Openings: Channel or bent plate sections; prime paint finish.
- G. Elevator Hoist Beams: Beam sections; prime paint finish.
- H. Elevator Sills: Provide angle shapes for slab edge locations and elevator sill supports; size in coordination with elevator manufacturer's requirements.
- I. Slotted Channel Framing: Fabricate channels and fittings from ASTM A1011/A1011M, Grade 33 structural steel complying with the referenced standards; with factory-applied, rust-inhibiting thermoset acrylic enamel finish.
 - 1. Provide 1-5/8 inch by 1-5/8 inch channel unless otherwise indicated.
- J. Bar Gratings: NAAMM MBG 531, welded or pressure-locked galvanized steel type. For all gratings, unless otherwise indicated, provide manufacturer's standard galvanized cross rods or bars spaced at 4 inches o.c.
 - 1. Elevator Sump Grating: Removable; type W-19-4 or P-19-4 per MBG 531; minimum 1-inch high by 1/8-inch thick galvanized steel bearing bars, spaced approximately 1-3/16-inch o.c.
 - 2. Provide welded frames for bar gratings, fabricated of galvanized steel shapes, with integral anchors/lugs for casting into concrete.
- K. Miscellaneous Steel Shapes: Provide steel shapes for miscellaneous applications indicated on drawings, including but not limited to, reinforcing steel shapes at low partitions/knee walls and concrete slab edge angles.

2.06 FACTORY FABRICATED STAIR NOSINGS

- A. Factory Fabricated Stair Nosings: For casting into concrete stairs.
 - 1. Materials: Extruded aluminum, alloy type 6063-T5, mill finish.
 - a. Tread Abrasive Filler: Aluminum-oxide epoxy-bonded to tread base.
 - b. Tread Type: Ribbed bar.
 - c. Nosing Types: Angled long nose for sloped stairs.
 - d. Color: Black.

- e. Depth: 3 inches nominal.
- 2. Manufacturers:
 - a. Balco, Inc.; R-315PC.
 - b. Nystrom, Inc; Ribbed Bar Nosing with EcoTread (STSB-ECO).
 - c. Wooster Products, Inc.; Type 231BF.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.07 ENCLOSURE GATES

- A. Enclosure Gates: Fabricate gate assembly, including steel gate posts, gate leaves, infill panels, and hardware, in configuration indicated. Galvanize all steel components.
 - 1. Gate Posts: Provide Schedule 80 steel pipe gate posts, unless indicated otherwise. Close tops of posts with cap plates, welded and ground smooth.
 - 2. Gate Framing: Provide 3-inch by 3-inch steel angle or bent plate for perimeter and intermediate framing of gates. Fabricate framing by welding; grind joints smooth.
 - 3. Provide all necessary bracing and reinforcement as required for square, level, and flush operable gates.
 - 4. Provide all fasteners, accessories, and hardware for a complete and operable gate assembly, unless indicated otherwise.
 - 5. Infill Panels: Provide prefabricated galvanized steel vision screen assembly for 100% visual screening. Infill panels may be secured to gate framing by welding or by mechanical attachments. If using fasteners, fasteners shall be concealed along sides of framing, with smooth exposed heads. Do not fasten to front faces of frame.
 - a. Products:
 - 1) Ametco Manufacturing Corporation; Shadow 100.
 - 2) Barnett Bates; Orsogril Talia 100.
 - 3) Substitutions: See Section 016000 - Product Requirements.
 - 6. Hardware: Provide the following:
 - a. Barrel Hinges: Exterior grade, weld-on type with grease fitting, of mild steel with stainless steel pin. Size to suit weight of gate, but rated not less than 600 pounds per hinge. Provide a minimum of two per gate leaf, unless indicated otherwise.
 - b. Pulls: Bent, 1/4-inch by 1-inch galvanized steel bar stock, welded to frame. Minimum 6-inch high by 2-inch deep pull. Provide one at each gate leaf, vertically mounted.
 - c. Staple and Hasp: To suit a standard padlock. Padlock is NIC.
 - d. Cane Bolts: Minimum 30 inch length, with attachment hangers/brackets that hold bolts in retracted position, and with a weld pin positioned to prevent cane bolt from being accidentally removed from lower bracket. Provide one per gate leaf. Provide receiver cups for each gate leaf in both the closed and 90 degree open positions, to allow for gates to be held open. Fill spaces around receiver cups with non-shrink grout.

2.08 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize and do not prime items to be embedded in concrete and items to be embedded in masonry. Do not prime items to be embedded in sprayed fireproofing.
- B. Prepare interior items to be primed in accordance with SSPC-SP3 Power Tool Cleaning.
- C. Prepare exterior items to be primed, and interior items to receive specialty protective coating such as zinc-rich primer, in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.

- D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- E. Prime Painting: One coat.
- F. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Slotted Channel Framing: ASTM A1011/A1011M Grade 33; coated with manufacturer's standard rust-inhibitive acrylic enamel.

2.09 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I color anodized.
- B. Apply corrosion protection coating to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.10 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

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 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.

3.03 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. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.
- E. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- F. Installation of Nosings: Center nosings on stair width with 4 inch inset at each end. Embed nosings in wet concrete, flush to top of each tread and aligned to front edge of each riser. Coordinate with concrete installer to tool concrete around the nosings for a smooth, clean finish. Remove protective masking tape after concrete has set and cured and clean any concrete residue.
- G. Installation of Bollards: Anchor bollards in concrete footings to a minimum depth of 36 inches with 6 inches of concrete below bottom of bollards. Fill bollards with concrete.
 - 1. At Contractor's option, provide either precast caps secured to wet concrete fill, or field-mound wet concrete fill to form a rounded cap.

- H. Installation of Gates: Anchor gate posts in concrete footings, to a minimum depth of 36 inches with 6 inches of concrete below bottom of posts.
1. Install gate leaf assemblies to smoothly operate without sagging or binding.
 2. Install all hardware for proper operation. Drill cores into concrete apron and install cane bolt receiver sleeves into cores flush with grade. Fill spaces around gate posts and cane bolt receivers with non-shrink grout.

3.04 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 055000

**SECTION 055100
METAL STAIRS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. 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.
- J. 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.
- K. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- M. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.02 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for metal stairs.
 - 1. Provide data for shop primer and for nonshrink grout.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

2. Design Data: Include delegated-design shop drawings, including structural calculations and details for loadings and stresses, and anchors and connections.
3. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
- C. Indoor Emissions: For each type of paint and coating, comply with the emissions requirements of California Department of Public Health (CDPH); "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers."
- D. VOC Content: For each type of paint and coating, comply with VOC content restrictions as required by 40 CFR 59, Subpart D (EPA's "National Volatile Organic Compound Emission Standards for Architectural Coatings").

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 - a. Head Clearance: Maintain a minimum of 80 inches head clearance along all paths of travel (the "walk line") as measured above stair noses or finished walking surfaces.
 2. Structural Design: Provide complete stair and railing assemblies that comply with the following:
 - a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.
 - 1) Deflection shall not exceed 1/720 of span where brittle finish materials such as stone, ceramic tile, or terrazzo are indicated.
 - b. Railing Assemblies: Refer to Division 5 "Pipe and Tube Railings."
 3. Dimensions: As indicated on drawings.
 4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels, per NAAMM AMP 510 "Metal Stairs Manual":
 1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.

- a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
 - b. Welds Exposed to View: Ground smooth and flush.
 - c. Mechanical Joints: Butted tight, flush, and hairline.
 - d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
 - e. Exposed Edges and Corners: Eased to small uniform radius.
 - f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
2. Industrial: All joints made neatly.
- a. Welded Joints: Welded on back side wherever possible.
 - b. Welds Exposed to Touch: Ground smooth.
 - c. Bolts Exposed to Touch in Travel Area: No nuts or screw threads exposed to touch.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Commercial, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
- 1. Concrete Depth: 1-1/2 inches, minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
 - 4. Concrete Reinforcement: Welded wire mesh.
 - 5. Concrete Finish: For resilient floor covering.
- D. Risers: Same material and thickness as tread pans.
- 1. Nosing Depth: Not more than 1-1/2 inch overhang.
 - 2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
- E. Stringers: Rolled steel channels.
- 1. Stringer Depth: 10 inches.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Railings: Steel pipe railings.

2.03 METAL STAIRS WITH METAL TREADS

- A. Jointing and Finish Quality Level: Industrial, as defined above.
- B. Risers: Open.
- C. Treads: Checkered steel plate.
- 1. Tread Thickness: 1/4 inch, minimum.
 - 2. Nosing: Plate bent to minimum radius with down return of 1 inch.
 - 3. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.
- D. Stringers: Rolled steel channels.
- 1. Stringer Depth: 10 inches.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.

- E. Landings/Platforms and Detention Housing Mezzanines: Same construction as treads, supported and reinforced as required to achieve design load capacity.
 - 1. Ceiling Closure Plates: Provide steel plate closure on underside of detention housing unit mezzanines, welded to perimeter structural components, to conceal conduit and piping for electrical, plumbing, and fire suppression elements, as indicated.
- F. Railings: Steel pipe railings.
- G. Finish: Galvanized after fabrication, except sheet components are to be galvanized before fabrication.

2.04 HANDRAILS AND GUARDS

- A. Handrails and Guards: See Section 055213.

2.05 MATERIALS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
- E. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- F. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.
- G. Reinforced Concrete Fill: Refer to Section 033000.

2.06 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15 or MPI #79, compatible with topcoat indicated in Division 9 Section "Painting," and comply with VOC limitations of authorities having jurisdiction.
 - 1. At exterior and galvanized surfaces, provide zinc-rich primer; SSPC-Paint 20 or MPI #20, compatible with topcoat, and VOC-compliant.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 or MPI #20, compatible with topcoat, and comply with VOC limitations of authorities having jurisdiction.
- E. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 055100

**SECTION 055133
METAL LADDERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements.
- B. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- H. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- M. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.
- N. NAAMM MBG 531 - Metal Bar Grating Manual.
- O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
- P. SSPC-SP 2 - Hand Tool Cleaning.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- C. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

- A. Design ladders 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. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A307, galvanized to ASTM A153/A153M where connecting galvanized components.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 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. 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.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED LADDERS

- A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish. Provide mounting brackets at top and bottom of ladder and at no more than 60 inches o.c. For elevator pit ladders, comply with requirements of ASME A17.1.
 - 1. Side Rails: 5/8 by 2-1/2 inch members spaced at 18 inches.
 - 2. Rungs: 3/4 inch diameter solid round bar spaced 12 inches vertically on center.
 - a. Cover top of each rung with a non-slip coating or with a premanufactured nonslip cover.
 - b. Space rungs 7 inches from wall surface.
 - 3. Platform: At roof-to-roof (parapet) locations, fabricate ladder with steel bar-grating platform, with 1/2-inch maximum openings between grating bars and 4-inch o.c. between grating crossbars. Provide with steel angle/bent plate frame.
 - a. Fabricate bar gratings in accordance with NAAMM MBG 531 "Metal Bar Grating Manual."
 - b. Provide walk-thru railing over top of platform at 42" minimum height, with intermediate rail at 21" above platform.

- c. Return: Provide side rails and rungs on the high roof side such that bottom rung will be less than 12 inches above roof surface.
- d. Do not secure ladder to roof surface or copings. Fasten only with brackets to vertical wall surface of parapet.
- 4. Telescoping Safety Post: Provide pre-fabricated safety post designed with telescoping tube section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism.
 - a. Unit shall be completely assembled and provided with fasteners for securing to ladder rungs in accordance with manufacturer's instructions.
 - b. Provide unit prefinished with manufacturer's standard safety yellow powder coat.

2.04 FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 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

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Masonry Walls: Confirm that masonry wall assemblies provide adequate structural support for anticipated ladder loads.
- C. Metal Framed Walls: Confirm that blocking and reinforcing have been installed in appropriate locations in the wall assembly to provide adequate structural support for anticipated ladder loads.

3.02 PREPARATION

- A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 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 shop drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 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 055133

**SECTION 055213
PIPE AND TUBE RAILINGS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- D. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.02 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for pipe and tube railings.
- B. Sustainability Submittals: Refer to Division 1 Section "Sustainable Design Requirements."
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Design Data: Include delegated-design shop drawings, including structural calculations and details for loadings and stresses, and anchors and connections.
 - 3. Include the design engineer's seal and signature on each sheet of shop drawings.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- E. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- C. Indoor Emissions: For each type of paint and coating, comply with the emissions requirements of California Department of Public Health (CDPH); "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers."
- D. VOC Content: For each type of paint and coating, comply with VOC content restrictions as required by 40 CFR 59, Subpart D (EPA's "National Volatile Organic Compound Emission

Standards for Architectural Coatings").

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide brackets, flanges, anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete or solid masonry, provide brackets anchored with drilled in expansion shields and hanger or lag bolts.
 - 2. For anchorage to hollow masonry, provide brackets anchored with toggle bolts.
 - 3. For anchorage to stud walls, provide brackets anchored with hanger or lag bolts to fire-retardant-treated wood blocking, or with toggle bolts to steel reinforcing backing plates.
 - a. Coordinate anchorage locations with Division 6 "Rough Carpentry" and / or Division 9 "Cold-Formed Steel Framing - Non-Structural (CFSF-NS)" to provide blocking or backing plates in framed walls, as applicable.
- G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, galvanized finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
- F. Shop and Touch-Up Primer: SSPC-Paint 15 or MPI #79, compatible with topcoat indicated in Division 9 Section "Painting," complying with VOC limitations of authorities having jurisdiction.
 - 1. At exterior and galvanized surfaces, provide zinc-rich primer; SSPC-Paint 20 or MPI #20, compatible with topcoat, and VOC-compliant.
- G. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.

2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- C. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. AWWA U1 - Use Category System: User Specification for Treated Wood.
- H. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- I. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.
- J. PS 1 - Structural Plywood.
- K. PS 20 - American Softwood Lumber Standard.
- L. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

- A. Product Data: Provide technical data for fire-retardant materials, wood preservative materials, and include certification that materials and treatment comply with manufacturer's requirements.
 - 1. Evaluation Reports: Provide ICC-ES evaluation reports for each applicable item below:
 - a. Preservative-treated lumber.
 - b. Fire-retardant-treated lumber.
 - c. Each type of engineered wood.
 - d. Shear panels.
 - e. Each type of power- or powder-actuated fastener and expansion anchor.
 - f. Structural wood connectors (framing anchors).

1.03 QUALITY ASSURANCE

- A. Testing Agency Qualifications (for Fire-Retardant Treatments): Independent firm specializing in performing testing of treatments of type specified in this section, and performing periodic inspections to ensure that the material receiving the classification marking matches the tested material; and approved by local authority having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
1. Grading Agencies: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org and who provides grading service for the species and grade specified.
 - a. Northeastern Lumber Manufacturer's Association (NELMA) - Spruce-Pine-Fir.
 - b. Southern Pine Inspection Bureau (SPIB) - Southern Pine.
 - c. West Coast Lumber Inspection Bureau (WCLIB) - Douglas Fir, Hem Fir, Spruce-Pine-Fir-South.
 - d. Western Wood Products Association (WWPA) - Douglas Fir, Hem Fir; Spruce-Pine-Fir-South.
 - e. National Lumber Grades Authority (NLGA) - Douglas Fir-North, Hem Fir-North, Spruce-Pine-Fir.
 2. Provide lumber stamped with grade mark of responsible grading agency, unless otherwise indicated.
 - a. Place grade stamp on unexposed surface of lumber specified to be exposed with natural or stained finish, or omit grade stamp and submit documentation from grading agency certifying grade compliance.
 3. Species and Grade:
 - a. Species and grade is indicated on Structural Drawings for studs, joists, rafters, beams, columns, ceiling joists, and other structural components, as applicable.
 - b. For miscellaneous lumber including non-structural miscellaneous framing, blocking, nailers, grounds, and furring, provide No. 2 or Standard grade.
 - c. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
 4. Moisture Content: S-dry or MC19 (19% or less). Applies to lumber for 2-inch nominal thickness and less.
- B. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either EPA (TSCA); Title VI for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).

2.02 WOOD CONSTRUCTION PANELS

- A. Roof Sheathing (Parapet, Vertical): Exposure 1, veneer faced FRT plywood sheathing. OSB is not acceptable.
1. Thickness: Minimum 5/8 inch.
 2. Screws for fastening plywood sheathing over rigid insulation at parapets:
 - a. For Steel Framing: Provide #10 SIP low profile flat head or pancake head screws intended for wood-to-metal connections, at spacing indicated.
 - 1) Pullout Capacity: 108 lb minimum in 43 mil (18 gauge) steel.
 - b. For Masonry Backup: 1/4-inch diameter, low-profile flat head type concrete screw anchors at 3 inches from each panel edge, and at spacing indicated. Length to suit embedment into CMU of 1-1/4 inches, minimum.
 - 1) Pullout Capacity: 100 lb minimum at 1 inch embedment in face shell of hollow CMU.

- B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 1/2 inch.
 - 1. At Assemblies Indicated with Fire-Rating: Use 5/8 inch Type X, required by indicated tested assembly.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Edges: Square.
 - 4. Products:
 - a. CertainTeed Corporation; GlasRoc Brand.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - c. National Gypsum Company; Gold Bond eXP Sheathing.
 - d. USG Corporation; Securock Brand Glass-Mat Sheathing Regular 1/2 in.
 - e. Substitutions: See Section 016000 - Product Requirements.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 25 or less, when tested in accordance with ASTM E84 (Class A - UL FR-S).

2.03 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Provide hot-dipped galvanized steel complying with ASTM A 153 or stainless steel at exterior, high humidity, and preservative-treated wood locations.
 - a. Fasteners at interior FRT shall be per FRT treatment manufacturer's recommendations.
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
 - 4. Screws/Anchors for Fastening Top-of-Parapet Blocking & Nailers and for Back-of-Parapet Plywood Sheathing over Rigid Insulation:
 - a. For CFSF-S Metal Framed Parapets: Provide #10 SIP low profile flat head screws intended for wood-to-metal connections, at spacing indicated. Pullout capacity of 108 lb minimum in 43 mil (18 gauge) steel.
 - b. For CMU Parapets: Provide 1/4-inch diameter low-profile flat head type concrete screw anchors, at spacing indicated. Length to suit embedment into CMU of 1-1/4 inches minimum. Pullout capacity of 100 lb minimum at 1 inch embedment in face shell of hollow CMU.
- B. Flexible Flashing/Separation Material: Barrier sheet fabricated of polyethylene backed rubberized asphalt or butyl rubber sheet; not less than 25 mil overall thickness.
- C. General Purpose Construction Adhesives: Comply with ASTM C557 or ASTM D3498.
 - 1. Adhesives: Adhesives field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.04 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Provide FRT lumber and plywood stamped with name and mark of qualified testing agency, fire-retardant treatment product and manufacturer, wood species and drying method, testing standards, and flame spread and smoke development indices.

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- a. For exterior FRT and FRT that will be exposed to moisture, include accelerated weathering test language, with the words "No increase in the listed classification when subjected to Standard Rain Test ASTM D2898".
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Fire Retardant Treatment:
1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat exterior rough carpentry items associated with roof construction, concealed blocking, and as indicated on Drawings.
 - c. Do not use treated wood in direct contact with the ground.
 2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat interior concealed blocking, plywood backing panels, and other rough carpentry items as indicated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
 3. Strength Adjustments (Structural Panels/Plywood): Test FRT structural panels/plywood per ASTM D 5516 and develop strength adjustment factors per ASTM D 6305.
 4. Strength Adjustments (Lumber): Test FRT lumber per ASTM D 5664 and develop strength adjustment factors per ASTM D 6841.
- C. Preservative Treatment:
1. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA). Do not use lumber or plywood treated with inorganic boron (SBX) for applications exposed to water, ground/soil contact, or interior floor slabs/concrete. Comply with additional treatment restrictions as required by local authorities having jurisdiction.
 2. Preservative Pressure Treatment of Lumber & Plywood Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Use Category UC2 is acceptable for interior lumber and plywood above grade (not in contact with floor slab).
 - b. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - c. Treat lumber exposed to weather.
 - d. Treat lumber in contact with roofing, flashing, or waterproofing.
 - e. Treat lumber in contact with masonry or concrete.
 - f. Treat lumber less than 18 inches above grade, and lumber located directly against below-grade exterior walls.
 - g. Treat lumber in other locations as indicated.

3. Preservative Pressure Treatment of Lumber in Contact with Ground/Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal-framed walls, provide continuous FRT blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In metal-framed walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where PPT blocking is indicated to be installed directly adjacent to metal decking or other galvanized metals, provide flexible flashing/separation material as a continuous barrier to prevent direct contact between materials.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Top-of-Parapet Blocking and Nailers: Secure wood blocking and plywood nailers to prepared substrate using mechanical fasteners to attain loading design requirements. Adhesive anchorage of wood nailers & blocking is not acceptable. Coordinate with installation of continuous insulation and air barrier membrane/roof membrane materials.
 1. Installation at CMU Parapets: Secure parapet blocking and nailers to CMU with screw anchors in two rows, staggered, at 32 inches on center; except within 10 feet of building corners provide two staggered rows at 24 inches on center. Provide fasteners sized for embedment length into CMU of 1-1/4 inch, minimum. Install screws in accordance with manufacturer's instructions, with screw heads flush with uppermost surface of indicated blocking or plywood nailer.
 2. Installation at CFSF-S Metal Framed Parapets: Secure blocking and nailers to metal framing at #10 SIP screws in 2 rows at 16 inches on center; except within 10 feet of building corners provide 2 rows at 12 inches on center. Provide attachment in accordance with APA Form No. T625C, Table 1; for 3/4 inch plywood thickness, wall stud spacing, and wind exposure category indicated.
- C. Back-of-Parapet Sheathing Over Rigid Insulation: Secure plywood sheathing over XPS / XEPS insulation to prepared substrate using mechanical fasteners to attain loading design

requirements. Adhesive anchorage is not acceptable. Coordinate with installation of continuous insulation and air barrier membrane/roof membrane materials.

1. Stagger vertical butt joints of plywood sheathing.
2. Installation at CMU Parapets: Secure sheathing over board insulation with screw anchors, embedment length of at least 1-1/4 inches into CMU substrate. Fastener spacing shall be 16 inches horizontally and 8 inches vertically.
3. Installation at CFSF-S Metal Framed Parapets: Secure sheathing over board insulation anchored directly to CFSF-S framing with #10 SIP screws. Fastener spacing shall be 16 inches horizontally and 8 inches vertically; verify with spacing of installed CFSF locations in field.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws as indicated.
 1. Screw panels to cold-formed steel framing.
 2. Space panels 1/8-inch apart.
- B. Communications and Electrical Room Mounting Boards: Secure with screws, to furring or to framing as applicable, with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.

3.06 CLEANING

- A. Waste Disposal: Refer to Section 017419 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 064100
ARCHITECTURAL WOODWORK AND CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.02 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.
- C. ANSI A208.1 - American National Standard for Particleboard.
- D. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. AWI (QCP) - Quality Certification Program.
- G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- H. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- I. BHMA A156.9 - Cabinet Hardware.
- J. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- K. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.
- L. EPA (TSCA); Title VI - Toxic Substances Control Act, Title VI: Formaldehyde Standards for Composite Wood Products.
- M. ISFA 2-01 - Classification and Standards for Solid Surfacing Material.
- N. NEMA LD 3 - High-Pressure Decorative Laminates.
- O. SCAQMD 1113 - Architectural Coatings.
- P. SCAQMD 1168 - Adhesive and Sealant Applications.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
 - 1. Include product data for each type of hardware and accessory.

- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Include field measurements, and indicate where field measurements differ from documents.
- C. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection.
- D. Fabricator Qualifications: Include evidence of accreditation with quality control program.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with experience on Projects of similar size and scope.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.
 - a. It is acceptable to subcontract portions of the work to a separate specialty subcontractor (for example, pre-fabricated plastic-laminate-faced casework); however, each fabricator shall be independently accredited; submit accreditation for each fabricator. The primary woodworking contractor shall be responsible for ensuring the work of all Division 06 sections is well coordinated and properly fabricated and installed.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodworking association quality certification service/program in accordance with requirements for work specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 2 of the Architectural Woodwork Standards: "Care & Storage."
- B. Deliver woodwork after finishes are complete, including painting, and HVAC is operating at occupancy conditions in all spaces where woodwork will be installed.
- C. Store in an environmentally controlled location. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of woodwork, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
 - B. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84, unless otherwise indicated for specific products.
 - C. All countertop surfaces shall be NSF approved for food contact.
 - D. Accessibility Requirements: Fabricate and install woodwork and casework in compliance with ICC/ANSI A117.1 and with ADA Standards for Accessible Design.
-

E. Low-Emitting Materials:

1. Composite Wood: Any composite wood materials installed inside the weatherproofing system shall meet either EPA (TSCA); Title VI for ultra-low-emitting formaldehyde or no added formaldehyde (ULEF / NAUF).
2. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
3. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Plastic-Laminate-Clad Cabinets: Custom grade, except as modified below. Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
 1. Style: Reveal overlay. Ease doors and drawer fronts slightly at edges.
 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 - a. Base Cabinets: 24 inches.
 - b. Tall Cabinets: 24 inches.
 - c. Wall Cabinets: 12-1/2 inches. (Minimum clear interior depth shall be 11 inches)
 3. Drawer Construction: Provide AWI premium grade for drawer box construction.
 4. Base Construction: Provide adjustable levelers for all base cabinets to facilitate load transfer to the floor, isolate cabinet ends from the floor, and permit leveling.
 - a. Provide one of the following two types of base construction:
 - 1) Separate Sub-Base: Cabinet sub-base shall be separate and continuous (no cabinet body sides-to-floor), exterior grade plywood with concealed fastening to cabinet bottom. Sub-base shall be ladder-type construction of individual front, back, and intermediates, to form a secure and level platform to which cabinets attach. Recess sub-base at exposed cabinet end panels 1/4 inch from face of finished end, for flush installation of finished base material by other trades.
 - 2) Integral Base: Provide end panels, cabinet bottoms, and horizontal toe kick members integrally joined together for structural strength. Adjustable levelers shall be provided at each corner for each cabinet.
 - b. Toe Kick: Toe kick shall be nominal 4 inch height. Reduce as necessary via field modification due to construction tolerances and concrete slab levelness to maintain maximum height dimensions indicated.
 5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
 - a. Finish: Matte or suede, gloss rating of 5 to 20.
 - b. Surface Color and Pattern: To be selected by Architect from manufacturer's full range.
 - c. Exposed Interior Surfaces: Thermally fused laminate (melamine) is acceptable only at drawer boxes. Provide HPDL, type VGS or CLS, at semi-exposed interiors of cabinets (cabinets with doors). Provide type VGS for exposed interior horizontal shelving surfaces and interiors of open cabinets (no doors).

- d. Apply undecorated laminate backing sheet to concealed reverse side of plastic laminate finished surfaces.
 - e. Wood Grain Pattern: If wood grain is indicated or selected for plastic laminate color/pattern, provide sequence matched finish across each elevation. Grain shall run vertically across all doors, drawers, fronts, and false fronts; mismatched grain direction is not allowed.
- C. ADA Sink Cabinets: Fabricate a panel of 3/4-inch moisture resistant core material and veneer/cladding material to match adjacent cabinets. Panel shall be removable for service access to undercounter plumbing. Provide with Z-clip attachment system for concealed fastening and with a steel cable retainer, minimum 4 feet long, so that panel can be set aside for service access. Fasten Z-clips and steel cable retainer to panel and to substrate with tamper-resistant fasteners.
- 1. Provide an undercounter vertical "apron" piece at front of ADA sink locations as indicated, flush to fronts of adjacent cabinets and finished to match.
- D. ADA Sink Cabinets with Doors: Provide casework manufacturer's standard hinged front door panels, with matching veneer/cladding material and toe kick built into door panels, to match appearance of adjacent base cabinets. Front door panels swing open to 160 degrees minimum to allow for ADA-compliant undercounter knee space and for plumbing access to sink.

2.03 WOOD-BASED COMPONENTS

- A. Low-Emitting Materials: Provide composite wood products that meet the requirements of EPA (TSCA); Title VI for formaldehyde emissions.
- B. Core Material for Cabinets: ANSI A208.1, Grade M-2 particleboard.
- 1. At Contractor's option, cabinet backs may be fabricated of ANSI A208.2, Grade MD fiberboard.
- C. Core Material for Countertops: Manufacturer's standard ANSI A208.1, Grade M-2 particleboard, or ANSI A208.2, Grade MD fiberboard.
- 1. At countertops containing sinks, provide core material meeting ANSI MR10 for moisture resistance. Available Products:
 - a. Arauco North America; Duraflake VESTA Moisture Resistant ULEF.
 - b. Collins Pine; FreeForm.
 - c. Georgia-Pacific; Ultrastock MR MDF.
 - d. Roseburg Forest Products; SkyBlend MR-10.

2.04 PANEL CORE MATERIALS

- A. Particleboard: Composite panel composed of cellulosic particles, additives, and bonding system; comply with ANSI A208.1.
- B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.

2.05 THERMALLY FUSED LAMINATE PANELS

- A. Thermally Fused Laminate (TFL): Melamine- or polyester-resin-saturated decorative papers; for fusion to composite wood substrates under heat and pressure.
- 1. Test in accordance with NEMA LD 3 Section 3.
 - 2. Panel Core Substrate: Particleboard.
 - 3. Color: White.

2.06 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation; High Pressure Laminate.
 - 2. Panolam Industries International, Inc; Nevamar Standard HPL.
 - 3. Panolam Industries International, Inc; Pionite Standard HPL.
 - 4. Wilsonart LLC; High Pressure Laminate (HPL).
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Color and Pattern: To be selected by Architect from Manufacturer's full range (standard and premium colors) in standard textured finish (textured gloss, fine textured, or suede finish). High gloss, heavy textured, metallic, or other special surface products (abrasion-resistant, chemical-resistant) will not be required for use in this project.
- D. Provide specific types as follows:
 - 1. Horizontal Countertop Surfaces: HGS, 0.048 inch (1.2 mm) nominal thickness.
 - 2. Vertical Surfaces and Non-Countertop Horizontal Surfaces: VGS, 0.028 inch (0.7 mm) nominal thickness.
 - 3. Cabinet Liner: CLS, 0.020 inch (0.5 mm) nominal thickness.
 - 4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.07 SOLID SURFACING MATERIAL

- A. Solid Surfacing Material: ISFA 2-01.
 - 1. Products:
 - a. Avonite Surfaces, a Brand of Aristech Surfaces, LLC; Avonite.
 - b. E. I. du Pont de Nemours and Company; Corian.
 - c. Formica Group; Solid Surfacing.
 - d. Hanwha L&C; Hanex.
 - e. LG Hausys America; HI-MACS.
 - f. Lotte Advanced Materials Co. Ltd.; Staron.
 - g. US Surface Warehouse; LivingStone.
 - h. Wilsonart LLC; Solid Surface.
 - 2. Thickness: 1/2-inch.
 - 3. Type: Standard Type.
 - 4. Color and Pattern: Provide colors per the following:
 - a. Colors and Patterns for Countertops: As selected by Architect from manufacturer's full range of colors equivalent to Dupont Corian price group 4.
 - b. Colors and Patterns for Window Stools: As selected by Architect from manufacturer's full range of colors equivalent to Dupont Corian price group 1.

2.08 COUNTERTOPS

- A. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Custom Grade and with manufacturer's requirements.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.

2. Core: Particleboard or fiberboard as specified, except provide moisture resistant type at sink locations.
 3. Exposed Edge Treatment: Square, substrate built up to 1-1/2 inch thick unless otherwise indicated; covered with 3 mm edge banding with eased ends.
 4. Back and End Splashes: 3/4-inch thick core material with Grade HGS face and 0.5 mm edge banding/tape at edges.
- C. Solid Surfacing Countertops and Window Stools: Solid surfacing sheet or plastic resin casting over structural substrate/core material.
1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 2. Core: Fabricate solid surface countertop core of manufacturer's recommended moisture-resistant MDF. Provide continuous structural substrate at unsupported/overhang conditions; ladder construction acceptable over cabinets. Build up core material for total countertop thickness indicated.
 3. Fabricate in accordance with manufacturer's standard requirements, and in one piece to the greatest extent possible.
 - a. Shop-fabricate cutouts and holes in solid surface for plumbing fixtures, deck-mounted soap dispensers, and other items indicated on Drawings.
 4. Provide manufacturer's standard configuration for exposed edges, back and end splashes, and per the requirements below:
 - a. Edge and Corner Profiles: Eased.
 - b. Provide built up edges to standard thickness indicated (1-1/2 inches unless otherwise indicated).
 - c. Provide 4 inch high back and end splashes, unless otherwise indicated.
 5. Window Stools: Scribe window stools to fit jamb conditions as indicated.

2.09 ACCESSORIES & ACCESSORY MATERIALS

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; of width to match component thickness.
 1. Provide 3 mm edge banding at all door and drawer front edges and laminate countertop edges.
 2. Provide 0.5 mm edge banding (tape) at cabinet body edges, shelf edges, and other semi-exposed/exposed interior edges.
 3. Color: To be selected by Architect from Manufacturer's full range to match selected laminate.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Standard plastic grommets for cut-outs, color as selected by Architect from manufacturer's full range.
 1. Grommet Size: To fit 2-1/2 inch diameter cut-out, nominal, unless otherwise indicated.
 2. Grommets shall have removable caps and slot for wire passage.
- F. Undercounter Wire Management: Provide the following, as indicated:

1. Vinyl J-shaped channel wire manager for undercounter mounting, continuous for full length of countertop.
- G. Undercounter CPU Mount: Adjustable, locking CPU tower mount that can be installed to underside of workstation countertop or to adjacent side wall. Minimum load capacity of 75 lbs.
 1. Products:
 - a. Knap & Vogt; CPU Holder 7300 Series (lockable).
 - b. Richelieu; Locking Slide & Swivel CPU Holder.
 - c. WorkRite Ergonomics; Track Mount 920 CPU Holder.
 - d. Substitutions: See Section 016000 - Product Requirements.
- H. Mailroom Casework Modules: Modular paper sorting assembly of closed-back, open-front case modules with adjustable horizontal shelves, fabricated of fire-resistant, impact-resistant, high-strength plastic or coated steel. Provide manufacturer's standard module sizes for overall unit dimensions and mail slot quantity required. Provide with metal nameplate at each mail slot.
 1. Manufacturers:
 - a. Datum Filing Systems.
 - b. Hamilton Sorter Company.
 - c. Modular Millwork, Division of International Office Products Cooperative.

2.10 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
 - B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated shelf rests, polished chrome finish, for nominal 1 inch spacing adjustments.
 - C. Workstation Brackets: Fixed, L-shaped, corner reinforced, face-of-stud mounting. Provide at all countertop/worksurface that is unsupported by cabinetry at 16 inches o.c., unless otherwise indicated.
 1. Materials: Formed steel shapes.
 - a. Finish: Manufacturer's standard, factory-applied, textured powder coat.
 - b. Color: Paint to match wall color.
 2. Load Capacity: 1000 lbs minimum per pair of brackets, tested at 16 inches o.c. spacing.
 3. Size: Provide nominal sizes below. Provide additional sizes as required for other countertop/workstation applications indicated on Drawings.
 - a. Provide 21 inches high by 28 inches deep for standard 30 inch deep countertops.
 - b. Provide 21 inches high by 21 inches deep for standard 25 inch deep countertops.
 4. Products:
 - a. A&M Hardware, Inc; Standard Brackets.
 - b. Best Brackets; ADA Workstation Support Standard Steel Bracket.
 - c. FastCap; SpeedBrace.
 - d. Lyman Associates; Counter Top Supports.
 - e. Substitutions: See Section 016000 - Product Requirements.
 - D. Concealed Countertop Support Brackets: Fabricated of 1/4-inch flat plate steel with 1/4-inch diameter mounting holes in vertical flange, for face mounting into framing substrate. Coordinate with countertop fabrication, provide additional shimming and furring to underside of countertop as required for flush installation. Finish color to be selected by Architect from manufacturer's full range. Provide at countertops 18" deep or less.
 1. Basis-of-Design Product; Federal Brace; Freedom Hidden Countertop Bracket.
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- E. Drawer and Door Pulls: BHMA A156.9, B02011, back-mounted "U" shaped wire pull, steel with satin finish, 4 inch centers.
- F. Cabinet and Drawer Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish. Provide on all cabinet doors and drawers unless otherwise indicated.
- G. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Heavy Duty grade.
 - a. For standard box drawers under 30 inches wide, provide BHMA Grade 1HD-100 with minimum load capacity of 100 lbf.
 - b. For file drawers and drawers 30 inches wide or larger, provide BHMA Grade 2HD-200 with minimum load capacity of 200 lbf.
 - c. For pencil drawer slides, provide 3/4 extension with minimum load capacity of 45 lbf.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide soft close type.
 - 6. Manufacturers:
 - a. Accuride International, Inc.
 - b. Fulterer USA.
 - c. Grass America Inc.
 - d. Knap & Vogt Manufacturing Company.
- H. Filing Cabinet Suspension System: Provide 14-gauge steel file suspension rails, epoxy powder coated. File followers, or other split bottom hardware, are not acceptable.
- I. Hinges: Butt type, BHMA A156.9, Grade 1, 2-3/4 inch, 5-knuckle steel with satin finish. Provide with antifriction bearings and rounded hospital tips.
 - 1. Provide two hinges for doors less than 48 inches high, and three hinges for doors more than 48 inches high.

2.11 DETENTION CASEWORK

- A. Fabricate casework indicated on the Drawings as "Detention Casework," or casework that is located within Detention areas, in accordance with AWI/AWMAC/WI (AWS) Premium grade. Locate equipment consoles, cabinets, and countertops in locations and configuration as indicated on Drawings.
 - 1. Provide plastic laminate casework utilizing particleboard core material as specified for general Division 06 casework.
 - 2. Provide solid surfacing countertops utilizing veneer-core plywood subtop.
- B. Solid Surface Countertops: Fabricate in accordance with AWI/AWMAC/WI (AWS) Premium grade and the following additional requirements:
 - 1. Countertops shall be constructed of 1/2 inch thickness solid-surface material with 3/4 inch veneer-core plywood subtop.
 - 2. Unsupported countertop spans shall not exceed 48 inches, and shall be reinforced to prevent deflection in excess of 1/4 inch under a 100 lb per square foot load.
 - 3. The maximum distance a solid-surface material countertop (with or without subtop) may cantilever from a support is 12 inches for 3/4 inch thick, or 6 inches for 1/2 inch thick material, whether in the front, back, or end.
 - 4. Install solid-surface countertops with support adequately furnished to minimize stresses and maximum full perimeter and joint support on all horizontal applications with a maximum on center separation between supports of 24" and with a maximum

unsupported and unloaded overhang of 6" for countertop with subtop.

- C. Provide the following hardware items in addition to hinges, shelf supports, and basic items specified for general casework applications:
 - 1. Provide grommets and wiretray required for installation of equipment items.
 - 2. Provide locks for all drawers and doors.
- D. Mount security control equipment within or on consoles as indicated on Drawings.
 - 1. Coordinate equipment requirements with the Security Control System Contractor (SCSC) prior to submitting shop drawings. Show coordination of detention equipment on the shop drawings.
 - 2. Locate wire management slots in countertop of size and location required to install monitors and keyboard with minimal exposure of wires from the countertop view. Finish wire management slots with vinyl grommets as specified.
 - 3. Provide for and coordinate installation of hopper pass and package pass units specified in Division 11 detention equipment sections.

2.12 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
 - 1. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.
 - 2. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
 - 3. Seal or prime paint concealed cut edges of wood and laminate casework.
- D. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- E. Apron Frames: Construction similar to other cabinets, with modifications.
 - 1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.
- F. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel exposed edges.
- G. Solid Surfacing: Fabricate in one piece to greatest extent possible; join pieces with adhesive sealant and finish joints smooth in accordance with manufacturer's recommendations and instructions.
 - 1. Fabricate with butt-jointed / square edge at all solid surface corners. Mitered solid surface corners are not acceptable.
- H. Countertop Fabrication: Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall, or as indicated.
 - 2. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

- I. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Height: 4 inches, unless otherwise indicated.
 - 2. Mechanically fasten back and end splashes to countertops with steel brackets at 16 inches on center.
- J. Wall-Mounted Counters (not mounted over cabinets): Provide ADA compliant knee space with brackets, skirts, or aprons, as indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver woodwork or casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point, and provide field modifications as required to not exceed maximum height dimensions.
 - 1. Construction tolerances shall not apply to casework maximum height dimensions; maximum indicated dimension shall be maintained at any point along the length of casework, regardless of floor levelness.
 - 2. Field modifications shall be made to the toe kick to account for leveling due to floor levelness.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 - 1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
 - 2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
- D. Verify adequacy of backing and support framing.
- E. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade(s) indicated and in accordance with manufacturer's instructions.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.

- F. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- G. Secure wall cabinets at top and bottom, at each end and no more than 16 inches on center. Secure directly into metal wall framing, or into FRT wood or metal channel blocking with No. 10 wafer head screws. Wall mounted hanger strips are not acceptable.
- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 064100

**SECTION 072100
THERMAL INSULATION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. NFPA 259 - Standard Test Method for Potential Heat of Building Materials.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 QUALITY ASSURANCE

- A. NFPA 285 Tested Assembly: Provide foam plastic insulation products located in exterior wall assemblies that have been tested in accordance with NFPA 285 which represent those exterior wall assemblies for this Project.
 - 1. Potential heat in Btu per square feet shall not exceed the potential heat of the foam plastic insulation contained in the wall assembly tested as determined by tests in accordance with NFPA 259.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect foam-plastic insulation from physical damage, including chipping, cracking, or soiling. Do not use boards that are damaged due to delivery or handling.
- B. Store insulation in a manner that protects from damage or deterioration, including moisture, soiling, or UV exposure.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Coordinate with insulation manufacturer for UV exposure requirements and coordinate the schedule of construction to ensure insulation is concealed in a timely manner.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.

2.02 BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
 3. Facing: Unfaced.
- B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

2.03 MISCELLANEOUS GAP / CRACK FILLER

- A. General: Fill miscellaneous joints and cracks with mineral wool batt insulation (specified above) or with closed-cell polyurethane foam at Contractor's option.
- B. Closed Cell Polyurethane Foam:
 1. Provide insulation that conforms to ULC S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material" or ASTM C 1029, Type II, and performance requirements listed.
 2. Flame-spread index of 0 and maximum smoke development index of 5, when tested in accordance with ASTM E84.
 3. Products:
 - a. Dow; Enerfoam Professional Foam Sealant.
 - b. Dupont; Great Stuff Pro Gaps & Cracks.
 - c. Hilti; CF-AS Crack and Joint All Seasons.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

- A. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 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.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.

- B. Apply adhesive to back of boards per manufacturer's instructions, or, at Contractor's option install insulation boards to tacky dampproofing/mortar parge coat before it has cured.
- C. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive/substrate contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

- A. Secure impale fasteners to substrate to manufacturer's required quantity and spacing.
- B. Install boards to fit snugly between wall ties.
- C. Install boards horizontally on walls.
 - 1. Install in running bond pattern.
 - 2. Butt edges and ends tightly to adjacent boards and protrusions.
 - 3. Place impale fastener locking discs.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.05 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

**SECTION 072736
SPRAYED FOAM (SPF) AIR BARRIER**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- B. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
- C. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- G. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.
- H. CAN-ULC-S705.1 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material Specification.
- I. CAN-ULC-S705.2 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.
- J. NFPA 259 - Standard Test Method for Potential Heat of Building Materials.
- K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.03 SUBMITTALS

- A. Product Data: Provide product description, insulation properties, and preparation requirements.
 - 1. Provide current Evaluation Service Report upon request.
- B. Compatibility Data: Provide manufacturer's data indicating compatibility between submitted SPF and transition membrane products.
- C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.
- D. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- E. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP):
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

- a. Install shall also be certified by ABAA/BPQI (Building Performance Quality Institute) in accordance with the training requirements outlined in the CAN-ULC-S705.2 Installation Standard. Installers shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request.
 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.
- B. NFPA 285 Tested Assembly: Provide foam plastic insulation products located in exterior wall assemblies that have been tested in accordance with NFPA 285 which represent those exterior wall assemblies for this Project.
1. Potential heat in Btu per square feet shall not exceed the potential heat of the foam plastic insulation contained in the wall assembly tested as determined by tests in accordance with NFPA 259.

1.05 MOCK-UPS

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Integrated Exterior Mockups: Attend preinstallation conference for and provide spray-foam components for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

1.07 WARRANTY

- A. Material Warranty: Manufacturer's standard warranty against manufacturing defects, for a minimum period of 3 years.
- B. Installation Warranty: Air barrier subcontractor's installation warranty, effective from date of Substantial Completion for a minimum period of 2 years. Installation warranty shall include all components of the air barrier assembly, including loss of airtight seal, loss of watertight seal, loss of adhesion, loss of cohesion, or failure to cure properly.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Spray Polyurethane Foam (SPF) Air Barrier/Insulation: Medium-density, rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 1. Provide insulation that conforms to CAN-ULC-S705.1 or ASTM C1029, Type II, and performance requirements listed.
 2. Thermal Resistance: R-value of 6.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
 3. Density: Minimum 1.9 pounds per cubic foot.
 4. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
 5. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 6. Air Permeance (Material): Not to exceed 0.004 cfm per square foot, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
 7. Ozone Depletion Potential (ODP): Zero.

8. Closed Cell Content: At least 90 percent.
9. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
10. Products:
 - a. BASF Corporation; WALLTITE US.
 - b. Henry Company; Permax 2.0 HFO.
 - c. Huntsman Building Solutions; ProSeal HFO Pro.
 - d. Johns Manville; JM Corbond IV Closed Cell Spray Polyurethane Foam.
 - e. NCFI Polyurethanes; InsulBloc HFO.
 - f. Substitutions: See Section 016000 - Product Requirements.
- B. Air Barrier Assembly Performance: Air barrier assembly, including primary air barrier and auxiliary materials, including joints and transitions to adjacent materials, shall have an air leakage rate not to exceed 0.04 cfm per square foot, at 1.57 psf pressure differential when tested per ASTM E2357. The air barrier assembly shall also serve as liquid water control layer, and shall be flashed to direct moisture to the exterior.

2.02 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Membrane at Transitions in Substrate and Connections to Adjacent Elements: Nominal 40-mil thick, impermeable, self-adhering sheet membrane.
 1. Available Products:
 - a. Carlisle Coatings and Waterproofing; CCW-705.
 - b. Grace Construction Products; Perm-A-Barrier Flashing.
 - c. Henry Company; Blueskin SA.
 - d. Protective Coatings Technology, Inc; Poly-Wall Crack Guard.
 - e. Tremco, Inc.; ExoAir 110.
 - f. W. R. Meadows, Inc.; Air Shield.
- C. Membrane at Transitions between Spray Foam Air Barrier and Roofing and Other Adjacent Materials: Provide impermeable transition membrane that complies with both air barrier manufacturer's recommendations and adjacent material manufacturer's recommendations.
- D. Spray Foam Stop and Screed: L-shaped stop and screed designed as a spray foam termination accessory, fabricated of stable UV-resistant plastic and acceptable to spray foam manufacturer. Outer leg shall be sized to match spray foam thickness indicated. "Jam-Ex" by Exo-Tec Manufacturing, Inc., or equivalent product.
- E. Counterflashing for Masonry Through-Wall Flashing: Nominal 40-mil thick, impermeable, self-adhering membrane.
 1. Available Products:
 - a. Carlisle Coatings and Waterproofing; CCW-705 TWF.
 - b. Grace Construction Products; Perm-A-Barrier Flashing.
 - c. Henry Company; Blueskin TWF.
 - d. Protective Coatings Technology, Inc.; Poly-Wall Crack Guard.
 - e. Tremco, Inc.; ExoAir TWF.
 - f. W. R. Meadows, Inc.; Detail Strip.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify work within construction spaces or crevices is complete before insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to the minimum cured thickness indicated on Drawings.
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- F. Building Expansion Joints: Do not bridge joints with spray foam material. Provide a L-shaped stop/screed on each side of joint, pack joint with compressible insulation, and bridge the joint with flexible transition membrane to provide continuous air barrier assembly.
- G. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
 - B. Field inspections and tests will be performed by a third party ABAA testing agency.
 - C. Inspection will include verification of insulation thickness and density.
 - D. Coordination of ABAA Tests and Inspections:
 - 1. Arrange and pay for testing and inspection required by ABAA QAP.
 - a. Testing and inspection shall verify conformance with ABAA Quality Assurance Program, the CAN-ULC-S705.2 Installation Standard, manufacturer's written installation instructions, and other requirements of this section.
 - b. Unless indicated otherwise, provide ABAA Quality Assurance Program audits in accordance with current "Frequency & Cost of Audits" posted on ABAA website. Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed. In the case of deficiencies, the ABAA-licensed inspector may verbally advise the licensed installer at time of inspection.
 - 2. Notify ABAA in writing of schedule for air barrier work. Allow adequate time for testing and inspection.
 - 3. Cooperate with ABAA testing agency.
 - 4. Allow access to air barrier work areas and staging.
 - 5. Do not cover air barrier work until tested, inspected, and accepted.
 - E. In addition to the ABAA site inspector, coordinate and provide access for air barrier manufacturer's technical representative to make field reviews during installation and provide technical reports to Contractor, Owner, and Architect.
 - F. Patch air barrier work that was removed or damaged due to testing.
-

- G. If testing and inspection reveals any defects, promptly remove and replace defective work at no additional expense to the Owner.

3.05 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION 072736

**SECTION 074113
METAL ROOF PANELS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- I. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- J. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- K. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
- L. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- M. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
 - 4. Include confirmation from metal roof panel manufacturer that submitted snow guard attachment is compatible with roof panel standing seam configuration and warranty requirements.
- B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.

2. Include details of vapor barrier/underlayment connection to membrane roofing system or other boundary construction to accomplish continuous air barrier system for an airtight building enclosure.
- C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
- E. Installer's qualification statement.
- F. Test Reports: Indicate compliance of metal roofing system to specified requirements.
- G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and approved by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of twenty years from Date of Substantial Completion.
- C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of twenty years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Standing Seam Metal Roof Panels:
 1. Architectural Metal Systems; Loc-Seam 360.
 2. ATAS International, Inc; 2" Field-Lok.
 3. Berridge Manufacturing Company; Double-Lock Zee-Lock Panel.
 4. Construction Metal Products, Inc; Series 2500.
 5. Drexel Metals Inc; 200S Profile.
 6. Elevate; UNA-CLAD UC-6.
 7. Englert, Inc; S2500.
 8. Fabral; Stand N Seam.
 9. IMETCO; Twin-Lok 2.0.
 10. MBCI; SuperLok.
 11. Merchant and Evans; 2" Zip Lok.
 12. Metal Roofing Systems, Inc; System 2500 - Metal Roof Panels.

13. Metal Sales Manufacturing Corporation; Magna-Loc 180.
14. Morin Corporation; SLR Standing Seam.
15. Petersen Aluminum Corporation; Tite-Loc Plus Panel.
16. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
 1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed $L/180$ of span length(L) when tested in accordance with ASTM E1592.
 2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
 3. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 1.57 lbf/sq ft, when tested according to ASTM E1680.
 4. Water Penetration: No water penetration when tested according to procedures and recommended test pressure of 2.86 lbf/sq. ft. according to ASTM E1646.
 5. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 120 degrees F.
 6. Thermal Resistance: Provide a minimum total roof assembly R-value of R-30. Polyiso insulation R-value shall be based on an industry standard Long Term Thermal Resistance (LTTR) of 5.7 per inch.
 7. Thermal Resistance: Provide a minimum system R-value of R-30 in accordance with ASTM C1289.
 8. Accelerated Weathering Test: Demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G155, or ASTM G154.
 9. Impact Resistance: Resist impact damage based on the results of tests in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470.

2.03 METAL ROOF PANELS

- A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed panels with factory-applied finish.
 1. Steel Panels:
 - a. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 galvanizing.
 - b. Aluminum-zinc alloy-coated steel complying with ASTM A792/A792M; minimum AZ50 coating.
 - c. Steel Thickness: Minimum 24 gauge, 0.028 inch.
 2. Profile: Standing seam, with minimum 1.75 inch seam height, and with intermediate ribs or striations; concealed fastener system for field seaming with special tool.
 - a. Panels shall be double-seamed (manufacturer's "double-lock", or 180 degree seam).
 3. Texture: Smooth.
 4. Length: Maximum possible length to minimize lapped joints. Where lapped joints are unavoidable, space laps so that each sheet spans over three or more supports.
 - a. End Lap Joints/Splices:

- 1) Coordinate splice location and fixed clip "point of fixity" with manufacturer's detailing to ensure entire roof system is coordinated for thermal movement.
 - 2) Lap panels with a minimum 6-inch lap; in shingle fashion to shed water to low side of roof.
5. Width: Panel coverage of 16 inches.

2.04 ATTACHMENT SYSTEM

- A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.
1. Provide a combination of fixed and floating clips to provide point of fixity at center of panel lengths; allowing for equal thermal movement toward each end.

2.05 FABRICATION

- A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
1. Portable Roll-Forming Equipment for Field-Fabricated Panels: Where panel length exceeds transportation capacity, use of UL-certified portable roll-forming equipment to produce full length panels on site is acceptable. Panels shall be warranted by manufacturer to be same as factory-formed products. Maintain UL certification of equipment for duration of the Work.
- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.06 FINISHES

- A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's full range.
- B. Concealed Surfaces: For interior surfaces of panels that will not be exposed in the finished work, provide epoxy primer and light-colored silicone-modified polyester (SMP) enamel or acrylic enamel topcoat, with minimum dry film thickness (DFT) of 0.5 mil.

2.07 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

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- D. Deck Sheathing: Glass mat faced gypsum panels, ASTM C1177/C1177M, fire resistant type, 1/2-inch-thick.
1. Products:
 - a. CertainTeed Corporation; GlasRoc Sheathing.
 - b. Georgia-Pacific Corporation; DensDeck Prime.
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. USG Corporation; Securock Glass Mat Roof Board.
 - e. Substitutions: See Section 016000 - Product Requirements.
- E. Vapor Retarder/Air Barrier Sheet; Self-Adhered: Minimum 30 mils.
1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 2. Water Vapor Permeance: 0.1 perms, maximum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
 3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
 4. Seam and Perimeter Tape: As recommended by sheet manufacturer.
 5. Products:
 - a. GCP Applied Technologies; Ice and Water Shield.
 - b. Henry Company; Blueskin RF200.
 - c. Owens Corning; WeatherLock.
 - d. Substitutions: See Section 016000 - Product Requirements.
- F. Thermal Insulation: Polyisocyanurate (ISO) board insulation, rigid cellular foam, complying with ASTM C 1289.
1. Classification: Type II.
 - a. Class 1 or Class 2 - Faced with glass fiber reinforced cellulosic felt or glass-fiber mat on both major surfaces of core foam.
 - b. Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
 - c. Thermal Resistance, R-value: Minimum Long Term Thermal Resistance of 5.7 per inch.
- G. High-Temperature Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 30 mil minimum total thickness; with strippable release film and slip-resistant woven polypropylene or polyethylene sheet top surface.
1. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
 2. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
 3. High Temperature Resistance: Passes thermal stability test at 240 degrees F, as specified in ASTM D 1970.
 4. Products:
 - a. Carlisle Coatings and Waterproofing; WIP 300HT.
 - b. Drexel Metals; MetShield.
 - c. GCP Applied Technologies, Inc.; Ultra.
 - d. Henry Company; Blueskin PE200HT.
 - e. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - g. Polyglass USA, Inc; Polystick MTS Self-Adhered High Temperature Roof Underlayment.
 - h. Substitutions: See Section 016000 - Product Requirements.

2.08 SNOW GUARDS

- A. Bar-Type Snow Guard: Continuous snow guard; provide manufacturer's standard assembly with an extruded aluminum bar/channel with slot for insertion of metal trim piece matching roof panel color. Metal panel manufacturer shall coordinate to provide matching metal trim.
 - 1. Clamps for Standing Seam Roof: Structural aluminum or stainless steel clamps secured to vertical standing seams of roof panels; non-penetrating.
 - 2. Products:
 - a. Alpine SnowGuards; SnowMax.
 - b. AceClamp by PMC Industries, Inc; Color Snap.
 - c. S-5!; ColorGard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

3.02 PREPARATION

- A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
- B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.
- C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.
- D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
- B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Insulation: Install insulation in a minimum of two layers, with joints of each succeeding layer staggered at least 6 inches in each direction. Install in total thickness as required for a total roofing assembly Long Term Thermal Resistance (LTTR) value of R-30 (minimum of 5.2 inches).
- D. Underlayment: Apply primer to substrate if required per manufacturer's instructions. Install self-adhering high temperature underlayment full coverage across entire roof surface, as the layer directly under metal roof panels. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 3-1/2 inches. Overlap side and end laps a minimum of 6 inches

and stagger at least 24 inches between courses. Roll all laps with a roller.

1. Comply with manufacturer's instructions for temperature and exposure requirements; but do not leave underlayment exposed for more than 14 days.
- E. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
 2. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.
- F. Snow Guards: Secure base clamps to metal roof panel seams at spacing recommended by manufacturer. Do not penetrate the metal roof panels. Provide one row of snow guards continuous along length of metal roofing, mounted at 24 inches up from gutter or eave, unless otherwise indicated.

3.04 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 074113

**SECTION 074213
METAL WALL PANELS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

1.02 SUBMITTALS

- A. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
- C. Selection Samples: Submit manufacturer's color charts representing manufacturer's standard range of available colors.
- D. Verification Samples: Submit physical samples in manufacturer's standard size indicating panel profile and selected color, for each type of product required.

1.03 MOCK-UPS

- A. Integrated Exterior Mockups: Attend preinstallation conference for and provide metal composite material panels and associated components for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.05 FIELD CONDITIONS

- A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Correct defective work within a twenty year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
- C. Weathertightness Warranty: Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Wall Panels - Concealed Fasteners:
 - 1. Basis-of-Design: MBCI; Masterline 16.
 - 2. ATAS International, Inc.
 - 3. Centria.
 - 4. Dimensional Metals, Inc.
 - 5. Englert, Inc.
 - 6. Fabral.
 - 7. Metal Roofing Systems, Inc.
 - 8. Morin Corporation.
 - 9. Substitutions: See Section 016000 - Product Requirements.

2.02 METAL WALL PANEL SYSTEM

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 - 1. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 - 2. Maximum Allowable Deflection of Panel: $L/180$ for length(L) of span.
 - 3. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 - 4. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 - 5. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 - 6. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.
- B. Concealed Fastener Exterior Wall Panels:
 - 1. Profile: Vertical; corrugated/ribbed with four asymmetrical ribs per 16 inch panel.
 - 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
 - 3. Material: Precoated steel sheet, 24 gauge minimum thickness.
 - 4. Texture: Smooth.
 - 5. Panel Width: 16 inches.
 - 6. Panel Depth: 7/8 inch.
 - 7. Color: To be selected by Architect from manufacturer's full range.
- C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- D. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed type, of profile to suit system.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- F. Anchors: Galvanized steel.

2.03 FINISHES

- A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's standard line.

2.04 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section 079200
- C. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
- D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.

3.02 PREPARATION

- A. Install subgirts/furring perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.
- B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.03 INSTALLATION

- A. Install panels on walls and soffits in accordance with manufacturer's instructions.
- B. Fasten panels to structural supports; aligned, level, and plumb.
- C. Locate joints over supports.
- D. Lap panel ends 2 inches, minimum.
- E. Provide expansion and control joints where length exceeds that recommended by manufacturer.
- F. Use concealed fasteners unless otherwise indicated by Architect.

3.04 TOLERANCES

- A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch, maximum.
- B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch, maximum.

3.05 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.06 PROTECTION

- A. Protect metal wall panels until completion of project.
- B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION 074213

SECTION 074213.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.
- F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- K. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- L. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives.
- M. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics.
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- O. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
 - 1. Require attendance by MCM installer, CI framing installer (if a different entity), and other relevant sub-contractors (such as aluminum storefront/curtain wall, air barrier, insulation).
 - 2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review procedures.
 - 3. Review in detail the schedule, personnel, and installation of adjacent materials and substrate.
 - 4. Review project specific details including joint details (both panel-to-panel joints and panel to adjacent construction), penetrations, openings.
 - 5. Review field testing, inspection, and other quality assurance requirements.

6. Review procedures for protection of work and other construction.

1.03 SUBMITTALS

- A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 1. Finish manufacturer's data sheet showing physical and performance characteristics.
 2. Storage and handling requirements and recommendations.
 3. Fabrication instructions and recommendations.
 4. Specimen warranty for finish, as specified herein.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 1. Physical characteristics of components shown on shop drawings.
 2. Storage and handling requirements and recommendations.
 3. Installation instructions and recommendations.
 4. Specimen warranty for wall system, as specified herein.
- C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, support clips, number of anchors, supports, reinforcement, trim, flashings, and accessories.
 1. Indicate panel numbering system.
 2. Differentiate between shop and field fabrication.
 3. Indicate substrates and adjacent work with which the wall system must be coordinated.
 4. Include large-scale details of anchorages and connecting elements.
 5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
 6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Selection Samples: Submit manufacturer's color charts representing manufacturer's standard range of available colors.
- E. Verification Samples: For each finish product specified, submit physical sample in manufacturer's standard size indicating selected colors.
- F. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.
- G. Test Report: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly utilizing identical products and components to those submitted for installation on this project.
- H. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
- I. Installer's qualification statement.
- J. Testing agency's qualification statement.
- K. Maintenance Data: Care of finishes and warranty requirements.

1.04 QUALITY ASSURANCE

- A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
 - B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
-

- C. Installer Qualifications: Company specializing in performing work of type specified in this section.
 - 1. Approved / certified in writing by wall panel system manufacturer.
- D. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

1.05 MOCK-UPS

- A. Integrated Exterior Mockups: Attend preinstallation conference for and provide metal composite material panels and associated components for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Protect finishes by applying heavy-duty removable plastic film during production.
 - 2. Package for protection against transportation damage.
 - 3. Provide markings to identify components consistently with drawings.
 - 4. Exercise care in unloading, storing, and installing panels to prevent bending, warping, twisting, and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation with tarpaulins or other suitable weathertight covering installed to provide ventilation.
 - 3. Store at a slope to ensure positive drainage of accumulated water.
 - 4. Do not store in enclosed space where ambient temperature can exceed 120 degrees F.
 - 5. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.07 FIELD CONDITIONS

- A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of wall panels. Complete forms in Owner's name and register with warrantor.
- C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Composite Material (MCM) Sheet Manufacturers:
 - 1. ALUCOBOND by 3A Composites USA; Alucobond Plus.
 - 2. Alcoa, Inc.; Reynobond FR.
 - 3. Alfrex, LLC; Alfrex FR.
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4. ALPOLIC Materials; ALPOLIC/fr (Fire Retardant core).
5. Fairview Architectural LLC; VitraBond G2 (Non-Combustible).

2.02 WALL PANEL SYSTEM

- A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage, or failure.
 1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
 2. Provide panel jointing and weatherseal using rainscreen drained and back ventilated (D/BV) "spline" type system. Use sealants only at perimeters where panel system abuts other materials and at exposed horizontal joints.
 3. Anchor panels to supporting framing without exposed fasteners.

2.03 PERFORMANCE REQUIREMENTS

- A. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
- B. Fire Performance: Provide panels that have been tested in approved assemblies, in accordance with, and complying with acceptance criteria of NFPA 285.

2.04 PANELS

- A. Panels: 1 inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
 1. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
 2. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
 3. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
 4. Fabricate panels under controlled shop conditions.
 5. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
 6. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
 - a. Make panel lines, breaks, curves, and angles sharp and true.
 - b. Keep plane surfaces free from warp or buckle.
 - c. Keep panel surfaces free of scratches or marks caused during fabrication.
 7. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
 8. Provide means of concealed drainage for panel condensation and water that might accumulate in members of system; drill perforated weep holes on underside return of each panel, and provide insect baffle at each weep hole.

2.05 MATERIALS

- A. Metal Composite Material (MCM) Sheet: Fire-retardant composite panel fabricated of two sheets of aluminum sandwiching a mineral-filled core; no foamed insulation material content.
 - 1. Overall Sheet Thickness: 0.157 inch, minimum (4 mm).
 - 2. Face Sheet Thickness: 0.020 inches, minimum, equal thickness for both exterior and interior facings. Unequal facings are not acceptable.
 - 3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
 - 4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 5. Flammability: Self-ignition temperature of 650 degrees F or greater when tested in accordance with ASTM D1929.
- B. Metal Framing Members: Coordinate with Section 054003 - Continuous Insulation (CI) Framing System, Clipped. Provide manufacturer's recommended installation clips, base and sill angles and channels, as required for complete installation over continuous insulation framing system.
 - 1. Provide material strength, dimensions, configuration as required to meet applied loads and in compliance with applicable building code.
 - 2. Aluminum Components: ASTM B209/B209M; or ASTM B221 (ASTM B221M).

2.06 FINISHES

- A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, with at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch.
- B. Color/Texture: To be selected by Architect from manufacturer's full range.

2.07 ACCESSORIES

- A. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.
 - B. CI Framing System: Refer to Division 5 Section 054003 - Continuous Insulation (CI) Framing System, Clipped.
 - C. Anchors, Clips, and Accessories: Use one of the following:
 - 1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
 - 2. Steel complying with ASTM A36/A36M and hot-dip zinc coating to ASTM A153/A153M.
 - 3. Steel complying with ASTM A36/A36M and hot-dip galvanized to ASTM A123/A123M, with Coating Thickness Grade of 100.
 - D. Fasteners:
 - 1. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
 - 2. Bolts: Stainless steel.
 - 3. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.
 - E. Joint Sealer: Provide color to match wall panels silicone sealant of type approved by MCM sheet manufacturer, and in compliance with ASTM C920.
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- F. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices, and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine dimensions, tolerances, and interfaces with other work.
 - 1. Verify that air barrier system/insulation and CI framing system are properly installed.
- B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
- F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- G. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
 - 1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
 - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
 - 3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
 - 4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
- I. Replace damaged products.
 - 1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.

2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

- A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

- A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION 074213.23

**SECTION 075419
PVC MEMBRANE ROOFING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- D. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- F. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. FM (AG) - FM Approval Guide.
- I. FM DS 1-28 - Wind Design.
- J. NRCA (RM) - The NRCA Roofing Manual.
- K. NRCA (WM) - The NRCA Waterproofing Manual.
- L. UL (FRD) - Fire Resistance Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at the Project site one week before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

- A. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- B. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Submit in the form of manufacturer's assembly letter, indicating each component of the roofing assembly as specified, and that assembly meets performance requirements and manufacturer's warranty conditions.
- D. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of products specified, with UL-listed roof assemblies for roof systems indicated.
- B. Installer Qualifications: Company specializing in installation of roof systems indicated, and approved / certified by roofing manufacturer to install products specified.
- C. Insulation Manufacturer Qualifications: Approved by roof membrane manufacturer, and approved and labeled under third party quality program as required by applicable building code.
 1. Insulation Labeling: All foam insulation shall bear the label of testing/inspection agency, and shall include manufacturer identification, product identification, performance characteristics, and other information as necessary to verify code compliance for intended end use.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact, unless otherwise indicated.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.06 FIELD CONDITIONS

- A. Do not install roofing materials during unsuitable weather, or when unsuitable weather is expected. Proceed only when field conditions are in accordance with roofing manufacturer's installation and warranty requirements.
- B. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- C. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
 - B. Special Warranty - Manufacturer: Manufacturer's standard warranty form, customized for project-specific conditions.
 1. Manufacturer's warranty shall be a "total system" or "edge-to-edge" warranty; no dollar limit ("NDL").
 2. Include all components of roofing system including, but not limited to, roofing membrane, roof insulation, adhesives and fasteners, flashings, edge metals and copings, substrate board, vapor retarder/air barrier, roof insulation, and cover board.
 3. Manufacturer's Total System Warranty Period: 20 years, from date of Substantial Completion.
 - C. Special Warranty - Installer: Installer shall sign and submit per warranty form attached at end of this section.
 1. Installer's warranty shall cover all components of roofing system, matching manufacturer's warranty above.
 2. Installer's Warranty Period: 2 years, from date of Substantial Completion.
-

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyvinyl Chloride (PVC) Membrane Roofing Materials:
 - 1. Carlisle SynTec Systems.
 - 2. Firestone Building Products, LLC.
 - 3. Flex Membrane International Corporation.
 - 4. GAF.
 - 5. Sika Corporation Roofing; Sarnafil PVC.
 - 6. Versico Roofing Systems.

2.02 ROOFING

- A. Thermoplastic Membrane Roofing: One ply PVC membrane, fully adhered, over cover board, insulation, vapor retarder/air barrier, substrate board, and metal roof deck
- B. Roofing Assembly Requirements:
 - 1. General: Installed roofing assembly and all associated components shall remain secure and watertight and shall withstand weather exposure, wind uplift pressures specified, and thermal movements. Roofing manufacturer shall certify that all roofing assembly components are compatible with each other and with adjacent materials for applications indicated.
 - 2. Roof Covering External Fire Resistance Classification: UL (FRD) Class A.
 - 3. Assembly Resistance to Internal Fire: Manufacturer's assembly shall be tested to and satisfactorily pass NFPA 276 or UL 1256.
 - 4. Wind / Uplift Design: Membrane roofing system shall be identical to system that has been successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to ASCE 7 as established by applicable building code and loading indicated.
 - a. Corner, Perimeter, Field-of-Roof Uplift Pressures: Per applicable building code and values indicated on Structural Drawings.
 - b. Static Uplift: In addition to uplift requirements above, system shall be tested for static uplift per FM 4474, UL 580, or UL 1897.
 - 5. Assembly Thermal Resistance (R-Value): Roofing assembly shall have a total minimum R-value of 30 in accordance with IECC for Commercial Buildings.
 - 6. Accelerated Weathering: 2,000 hours minimum exposure, when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
 - 7. Ponding: Ponding water shall not remain on the roof 24 hours after a rainfall event.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:
 - 1. PVC: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M, Type II, sheet contains reinforcing fibers or reinforcing fabrics.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
 - 2. Sheet Width: Factory fabricated into widest possible sheets.
 - 3. Color: White.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane.

2.04 DECK SUBSTRATE BOARD

- A. Thermal Barrier: Deck substrate board shall serve as an approved thermal barrier, as required by applicable building code, separating foam plastic roof insulation from the interior of the building.
- B. Deck Substrate Board: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 - 1. Thickness: 1/2 inch, fire-resistant.
 - 2. Products:
 - a. CertainTeed Corporation; GlasRoc Sheathing.
 - b. Georgia-Pacific; DensDeck Prime.
 - c. National Gypsum Company; DEXcell Glass Mat Roof Board.
 - d. USG Corporation; Securock Ultralight Glass-Mat Roof Board.

2.05 VAPOR RETARDER / AIR BARRIER

- A. Vapor Retarder / Air Barrier Sheet, Self-Adhered: Composite sheet fabricated of rubberized asphalt factory laminated to polyethylene/polypropylene film with release liner. Product shall be approved by primary roofing manufacturer, and comply with the following:
 - 1. Total Thickness: 30 mils, minimum.
 - 2. Air Permeance: Less than 0.004 cfm/sq.ft. when tested per ASTM E 2178.
 - 3. Vapor Permeance: Less than 0.1 perm when tested per ASTM E 96.
 - 4. Products:
 - a. Carlisle; VapAir Seal 725 TR.
 - b. Firestone; V-Force Vapor Barrier.
 - c. GAF; SA Vapor Retarder XL.

2.06 COVER BOARDS

- A. Cover Board: High compressive strength polyisocyanurate (ISO) board insulation complying with ASTM C1289, and the following characteristics:
 - 1. Classification: Type II, Class 4 - Faced with coated or uncoated polymer-bonded glass fiber mat facers on both major surfaces of the core foam.
 - 2. Compressive Strength: Type II, Class 4; Grade 1, 80 psi.
 - 3. Board Thickness: 1/2 inch.
 - 4. Thermal Resistance: R-value of 2.5, minimum, at 1/2 inch thick and 75 degrees F mean temperature.
 - 5. Products:
 - a. Carlisle; SecurShield HD.
 - b. Firestone; Isogard HD Cover Board.
 - c. GAF; EnergyGuard HD.

2.07 INSULATION

- A. Surface Burning Characteristics: Foam plastic insulation shall have a maximum flame spread index of 75, and maximum smoke developed index of 450, when tested in accordance with ASTM E84 at maximum thickness intended for use.
- B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II:

- 1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
- 2) Compressive Strength: Grade 2 - 20 psi, minimum.
2. Tapered Board: Slope as indicated, but no lower than 1/4 inch per foot; minimum thickness 1/2 inch; fabricate of fewest layers possible.
3. Preformed Shapes: Provide saddles crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, but no less than 1/4 inch per 12 inches, and no less than 1/8 inch per 12 inches in valleys.

2.08 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Sheathing Joint Tape: Paper type, self adhering.
- C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.
- D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- E. Membrane Adhesive: As recommended by membrane manufacturer.
- F. Insulation Adhesive: As recommended by insulation manufacturer.
- G. Sealants: As recommended by membrane manufacturer.
- H. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 1. Composition: Roofing membrane manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and other accessories are in place.

3.02 PREPARATION - METAL DECK

- A. Install deck sheathing on metal deck:
 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 3. Tape joints.
 4. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
 - a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the

bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.

3.03 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder over sheathing surface in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation:
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM DS 1-28 Factory Mutual requirements.
 - a. At locations where metal roof deck will be exposed from below in the finished work, carefully coordinate fastener attachment such that fasteners do not penetrate the bottom flanges of the metal deck. Remove fasteners that penetrate the bottom flanges and replace with properly located fasteners, and restore metal deck to Owner's satisfaction.
 - 2. Embed subsequent layer(s) of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
 - 3. Install a minimum of two layers of insulation, with a minimum total thickness of 5 inches, to achieve a cumulative Long Term Thermal Resistance (LTTR) value of 28.5 per ASTM C 1289, followed by a cover board.
- D. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- H. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- I. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- J. Do not install more insulation than can be covered with membrane in same day.

- K. Cover Boards: Secure cover boards in accordance with roofing manufacturer's instructions with manufacturer's insulation adhesive. Install cover boards with joints staggered minimum 6 inches from joints of preceding insulation layer.

3.05 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate per manufacturer's instruction. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints where indicated. Make joints watertight.
- H. Coordinate installation of roof drains and sumps and related flashings.
- I. Install walkway pads in layout indicated. If not indicated, provide from roof access hatch/door to each major piece of rooftop equipment and fully around perimeter of equipment. Space pad joints to permit drainage.

3.06 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide on-site inspection by roofing manufacturer's technical representative at least three times (deck/substrate examination, in-progress, and warranty inspection) during installation of this work.
- C. Repair or replace roofing components where inspection determines they are defective.
 - 1. Repair or replace roofing system where ponding occurs in excess of specified requirement.

3.07 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.
- D. Provide a final cleaning of the roof membrane immediately prior to Substantial Completion to remove dirt, clay and other soiling.

3.08 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 075419

ROOFING INSTALLER'S WARRANTY

WHEREAS _____

of (Address) _____

herein called the "Contractor," has provided roofing and associated "work" on the following project:

Owner: _____

Address: _____

Name of Building: _____

Address: _____

Area of Work: _____ Date of Acceptance: _____

Warranty Period: _____ Date of Expiration: _____

Roofing Contractor: _____

Address: _____

AND WHEREAS Contractor has contracted directly with the Owner to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period.

NOW THEREFORE the (General) Contractor shall maintain the entire roof system in a completely water-tight condition at no cost to the Owner for two (2) years from date of final acceptance; except this water-tight guarantee shall not be enforced when the Contractor can prove water damage was caused by the Owner.

This guarantee covers the roofing membrane and flashing, metal flashing, parapet coping, and properly detailed penetrations of the roofing membrane for such things as stacks, curbs, and expansion joints which exist when the work is performed.

The Roofing Contractor shall guarantee its materials and workmanship associated with the roofing, flashings, and sheet metal work incidental to the work required under the roofing subcontract, against defect due to faulty materials or workmanship for a period of two (2) years from the date of completion of such work. It is understood and agreed by all parties hereto that the responsibility of the roofing contractor under this guarantee form or any contract document shall be limited to the limited guarantee herein expressed by said roofing contractor.

The undersigned named Owner for the Commonwealth agrees, from the date of acceptance of the project, to maintain the roof in accordance with the manufacturer's written requirements and agrees to avoid damage to the roof surface by any parties under his control working or walking on the roof. The Owner recognizes his responsibility to inspect the roof semi-annually.

IN WITNESS THEREOF, this instrument has been duly executed this

_____ day of _____, 20_____.

General Contractor (Firm)

By:

Name

Authorized Signature

Roofing Contractor (Firm)

By:

Name

Authorized Signature

Owner

By:

Name

Authorized Signature

END OF SECTION

**SECTION 076200
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used including technical material properties.
 - 1. Include installation instructions and manufacturer's recommendations for installation and maintenance.
 - 2. Include ANSI/SPRI/FM 4435/ES-1 wind pull-off performance data for systems that will be used in edge metal conditions.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.
- D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work, with experience in projects of size and scope similar to this Project.

1.04 MOCK-UP

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Integrated Exterior Mockup: Attend preinstallation conference and provide metal flashing/trim work for integrated exterior mockup as indicated on Drawings and as specified in Division 1 Section "Quality Requirements."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge (0.028-inch) thick base metal, shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: To be selected by Architect from Manufacturer's full range.
- B. Pre-Finished Aluminum: ASTM B209/B209M; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating.
 - 2. Color: To be selected by Architect from Manufacturer's full range.
- C. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 24 gauge (0.025-inch) thick; smooth No. 2D finish.
- D. Copper: ASTM B370, cold rolled 16 oz/sq ft, 24 gauge, 0.0216 inch thick; natural finish.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Tin edges of copper sheet to be soldered; solder shop formed metal joints, and after soldering, remove flux, wipe and wash solder joints clean; provide weathertight joints.
- F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
 - 1. Hem exterior corners of flashings and drip edges, in a manner that eliminates sharp, exposed cut metal edges, at locations below 6'-0" above grade (locations within reach range of building occupants).
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.03 GUTTERS AND DOWNSPOUTS

- A. General: Provide minimum 0.040-inch aluminum extrusions for gutters and minimum 0.032-inch aluminum for downspouts. Finish all parts of gutter/downspout system a single color to match, including brackets, elbows and bends, and exposed fastener heads.
- B. Gutters: SMACNA Ogee profile (Style K); unless otherwise indicated.
- C. Downspouts: Rectangular profile; unless otherwise indicated.

- D. Gutter and Downspout Sizing: Unless otherwise indicated, provide 4-inch deep by 5-inch wide downspouts, with gutter depth to accept 4-inch deep downspout.
- E. Accessories: Profiled to suit gutters and downspouts. Provide additional elbows, bends, extended bracket depths, and other accessories as required for downspouts to avoid conflict with cladding profiles, masonry or precast extrusions, and other surface ornamentation on wall.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Straps and spacer bars (SMACNA figure 1-17), spaced no more than 24 inches on center.
 - 3. Downspout Supports: Brackets; spaced no more than 60 inches on center.
 - 4. Downspout Strainers: Provide ball-type mesh strainer at each downspout; pre-fabricated, non-corrosive construction compatible with gutter/downspout material.
- F. Splash Blocks: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment. Lightweight "patio" blocks are not acceptable.
 - 1. Provide a splash block at all conditions where downspout is not indicated to connect to downspout boot, and at conditions where downspout empties onto lower roof.
- G. Downspout Boots: Cast iron, inlet sized to match downspout; outlet sized for underground drainage piping. Coordinate with Plumbing Drawings and Division 22.
- H. Seal metal joints.

2.04 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer Type: Zinc chromate.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- F. Reglets and Counterflashings (Masonry): Embedded type, copper. Coordinate with Division 4 Section "Unit Masonry."
- G. Reglets and Counterflashings (Non-Masonry): Surface mounted two-piece reglet and counterflashing, or one-piece counterflashing, fabricated of pre-finished aluminum or galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets and one-piece counterflashings true to lines and levels, and seal tops with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

- A. Comply with SMACNA installation instructions and drawing details.
- B. For reglets installed into masonry veneer, furnish reglets to mason for installation as Division 4 Unit Masonry work progresses.
- C. Insert flashings into reglets to form tight fit; secure in place with wedges; seal flashings into reglets with sealant.
- D. Secure flashings in place using concealed fasteners.
- E. Apply plastic cement compound between metal flashings and felt flashings.
- F. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- G. Seal metal joints watertight.
- H. Secure gutters and downspouts in place with concealed fasteners.
- I. Slope gutters 1/4 inch per 10 feet, minimum.
- J. Connect downspouts to downspout boots, and grout connection watertight.
- K. At low roof conditions, and where not indicated to connect to downspout boots, provide a bottom elbow and set splash blocks under downspouts.

END OF SECTION 076200

**SECTION 077100
ROOF SPECIALTIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems.
- C. NRCA (RM) - The NRCA Roofing Manual.

1.02 SUBMITTALS

- A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
 - 1. Include test data/confirmation that copings and edge metals conform to ANSI/SPRI/FM 4435/ES-1 performance requirements.
- B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- C. Samples for Selection: Provide manufacturer's color charts for each product and material requiring color selection.
- D. Samples for Verification: Submit physical samples, manufacturer's standard size, for each selected color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Roof Edge Metals and Copings: Provide private-labeled products by one of the roofing manufacturers listed in Division 7 roofing section(s) as required to meet requirements and comply with terms of manufacturer's total system warranty.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Fascia, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
- B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
 - 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
 - a. Provide cantilever design sized for installation over masonry veneer without attachment to veneer.
 - b. Size copings to allow for cavity ventilation; do not block top of cavity with continuous nailers, and do not seal between coping and front veneer.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local

- building code.
- 3. Wall Width: As indicated on drawings.
- 4. Outside Face Height: 6 inches.
- 5. Inside Face Height: 5 inches.
- 6. Material: Formed aluminum sheet, 0.050 inch thick, minimum, for wall thickness up to 15 inches. Provide minimum 0.063 inch thick where total wall thickness is over 15 inches..
- 7. Finish: AAMA 2605, 70 percent polyvinylidene fluoride (PVDF).
- 8. Color: To be selected by Architect from Manufacturer's full range.
- 9. Products:
 - a. Carlisle; SecurEdge 200 Cantilever Coping.
 - b. Firestone; Firestone Gold Cantilever Coping.
 - c. Johns Manville; Perma-Tite Gold Cantilever Coping.
- C. Roof Penetration Sealing Systems: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- D. Multiple Penetration/Pipe Housing: Where multiple penetrations are required in close proximity, provide pipe chase housing fabricated of structural aluminum or galvanized steel curb, pre-finished aluminum chase housing with removable top cover, and individual gasketed pipe seals which exit the side walls of the housing. Size housing and provide number and size of pipe seals as required for each application.
 - 1. Manufacturers:
 - a. Alta Products, LLC; Sigrist Pipe Chase Housing.
 - b. Roof Penetration Housings, LLC; the Vault.

2.03 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.

2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
 - 1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.
- C. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

- B. Install components weathertight; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- C. Seal joints within components when required by component manufacturer.
- D. Anchor components securely.
- E. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- F. Coping Installation: Install coping cleats and chair with concealed fasteners. Anchor as required to meet ANSI/SPRI performance requirements and manufacturer's instructions, but at spacing of no greater than 36 inches on center.
- G. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION 077100

**SECTION 077200
ROOF ACCESSORIES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF CURBS

- A. General: Coordinate with Division 22, 23, and 26 for roof curbs and equipment supports specified with specific pieces of equipment.
- B. Roof Curbs Manufacturers:
 - 1. AES Industries Inc.
 - 2. Curbs Plus, Inc.
 - 3. The Pate Company.
 - 4. LMCurbs.
 - 5. Roof Products & Systems (RPS).
 - 6. Thybar Corporation.
 - 7. Substitutions: See Section 016000 - Product Requirements.
- C. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
 - 1. Roof Curb Mounting Substrate: Curb substrate consists of corrugated metal roof deck with insulation.
 - 2. Sheet Metal Material: Galvanized (zinc-coated) or galvalume (aluminum-zinc alloy) steel sheet; minimum 18 gauge (0.052-inch) thick; mill finish.
 - 3. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
 - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch clearance between curb and metal roof panel flange allowing water to properly flow past curb.
 - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.

- c. Maintain at least 12 inch clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
 - d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
 - 4. Provide layouts and configurations indicated on drawings.
- D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
 - 1. Provide preservative treated wood nailers along top of rails.

2.02 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 - 1. Bilco Company; Model S-50TB.
 - 2. Milcor, Inc; Thermal Pro TP-1.
 - 3. Nystrom, Inc; ThermalMAX RHTA.
 - 4. Substitutions: See Section 016000 - Product Requirements.
 - B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - 1. Mounting Substrate: Provide frames and curbs suitable for mounting on standing seam metal roof panel system.
 - a. Coordinate with roof insulation height, including tapered insulation design as indicated, to provide a minimum 8 inch curb height above the highest adjacent point of roof membrane.
 - 2. Thermally Broken Hatches: Provide manufacturer's standard insulation and thermally-broken frame and cover.
 - 3. For Ladder Access: Single leaf; 30 by 36 inches.
 - 4. Operation and Hardware: Provide with manufacturer's standard gas springs with assisted lift and automatic hold open arm. Provide interior and exterior turn handles and interior padlock hasp (padlock NIC).
 - C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
 - 2. Insulation: Manufacturer's standard; 3 inch rigid polyisocyanurate, located on outside face of curb.
 - D. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.
 - 2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
 - 3. Insulation: Manufacturer's standard 3 inch rigid glass fiber.
 - 4. Gasket: Neoprene, continuous around cover perimeter.
 - E. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb. Do not install safety railing to roof assembly.
 - 1. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
 - 2. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
 - 3. Posts and Rails: Manufacturer's standard galvanized steel, aluminum pipe, or fiberglass pipe; pre-finished in safety yellow color.
 - 4. Fasteners: Stainless steel, Type 316.
 - 5. Products:
-

- a. BILCO Company; Bil-Guard 2.0.
- b. Milcor, Inc.; SAF-T-RAIL.
- c. Nystrom, Inc.; Roof Hatch Safety Railing SRC.
- d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.
- B. Roof Curbs and Equipment Supports: Install in lengths and in a manner such that curbs and equipment supports span multiple structural framing members, with adequate blocking and supports to distribute the equipment loads over metal decking and structural members without crushing.

3.04 CLEANING

- A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 077200

**SECTION 078100
APPLIED FIRE PROTECTION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. ASTM E605/E605M - Information Technology Equipment – Safety - Part 1: General Requirements.
- D. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
- E. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members.
- F. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.
- G. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members.
- H. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- J. AWC Technical Manual 12-B - Standard Practice for the Testing and Inspection of Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.
- K. UL 263 - Standard for Fire Tests of Building Construction and Materials.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.
- B. Coordinate temporary enclosures to confine spraying operations and protect the environment and adjacent materials; and for protection of applied fire protection from environmental conditions and exposure to weather.
- C. Coordinate with roofing work; do not apply fireproofing until installation of roofing, rooftop units, and other associated work is completed.
- D. Coordinate with subsequent construction operations; avoid unnecessary exposure of fire-resistive materials to abrasion and other damage likely to occur after application.
- E. Coordinate special inspections scheduling; Contractor shall notify Owner and Special Inspector when fireproofing is completed and ready for inspections and testing.
- F. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review products to be installed, including density and bond strengths, unrestrained conditions, sequencing and schedule coordination, coordination with roofing work, surface conditions and preparation, environmental conditions, and quality-control testing and inspection.

1.03 SUBMITTALS

- A. Product Data: Provide data indicating product characteristics, performance criteria, and limitations of use.
- B. Shop Drawings: Submit drawings that indicate extent of applied fire protection, for each type and rating.
 - 1. Include assembly designations by UL or other qualified test agency at each location.
 - 2. Include required thicknesses to achieve indicated ratings, at each location.
- C. Manufacturer's Certificate: Certify that applied fireproofing products meet or exceed requirements of Contract Documents.
- D. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, as follows:
 - 1. Bond strength.
 - 2. Bond impact.
 - 3. Compressive strength.
 - 4. Fire tests using substrate materials similar those on project.
- E. Field Quality Control Submittals: Submit field test report.
- F. Manufacturer Reports: Indicate procedures followed, environmental conditions that applied fireproofing materials were installed, and supplementary instructions given.
- G. Installer's Qualification Statement.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and approved / certified by manufacturer.

1.05 FIELD CONDITIONS

- A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.
- B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
- C. Provide temporary enclosure to prevent spray from contaminating air.
- D. Do not allow roof traffic during installation of fireproofing under roof deck, and during drying period.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
 - B. Special Warranty - Installer: Installer shall submit warranty form agreeing to repair or replace applied fire protection that fails in materials or workmanship within the specified period.
 - 1. Installer's warranty shall cover cracking, spalling, flaking, peeling, or delamination of fire protection from substrates.
 - 2. Warranty shall not cover failure due to damage by occupants or Owner's personnel, exposure to environmental conditions outside those tested and approved, and other causes not reasonably foreseeable under conditions of normal use.
-

3. Installer's Warranty Period: 2 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Fireproofing Assembly Design:
 1. Fire-Resistance Designs: As indicated on Drawings; products specified in this section shall be certified fire-resistance designs and shall have been tested by a qualified testing agency in accordance with ASTM E119 or UL 263. Provide applicable markings identifying testing agency on product containers/packaging.
 2. All design applications for this project are for unrestrained conditions unless explicitly stated otherwise in the contract documents for specific locations.
 3. Fire-resistance design thicknesses for open web steel joists shall be based on testing at a maximum allowable stress of 30 ksi matching SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Asbestos-Containing Material: All fire-resistive products and accessory products shall be certified by Contractor as containing no asbestos.

2.02 MATERIALS

- A. Applied Fire Protection Material for Interior Applications, Concealed: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
 1. Bond Strength: 330 pounds per square foot, minimum, when tested in laboratory in accordance with ASTM E736/E736M. Refer to Part 3 article "Field Quality Control" for field testing requirements.
 2. Dry Density: 15 lb/cu ft, ("Standard" density) minimum, when tested in accordance with ASTM E605/E605M.
 3. Compressive Strength: 10 lbf/sq. in., minimum, when tested in accordance with ASTM E761/E761M.
 4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
 5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
 6. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859/E859M after 24 hours.
 7. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
 8. Effect of Deflection: No cracking, spalling, or delamination, when tested in accordance with ASTM E759/E759M.
 9. Fungal Resistance: No growth after 28 days when tested according to ASTM G21.
 10. Manufacturers:
 - a. GCP Applied Technologies; Monokote MK-6.
 - b. Isolatek International; Cafco 300 or Cafco Blaze-Shield II.
 - c. Southwest Fireproofing Products Co.; Type 5GP.

2.03 ACCESSORIES

- A. Primer Coating: Of type recommended by applied fire protection manufacturer.
- B. Water: Clean, potable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- D. Verify that voids and cracks in substrate have been filled.
- E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.02 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- E. Close off and seal duct work in areas where fireproofing is being applied.

3.03 APPLICATION

- A. Apply primer adhesive in accordance with manufacturer's instructions.
- B. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.
- C. Where a protected steel member connects to another protected steel member with a greater thickness of applied fire-resistant material, provide applied fireproofing equal to the greater thickness on all members for a minimum distance of 18 inches from the point of attachment.
- D. Where unprotected steel elements connect to protected steel members, the unprotected elements shall be coated with the same thickness of material applied to the protected members for a minimum distance of 18 inches from the point of attachment. Unprotected elements that shall be coated include structural steel members that do not otherwise require protection and also include any non-structural elements that connect to protected members, including CFSF members, clips, hangers, support sleeves, and similar items.

3.04 FIELD QUALITY CONTROL

- A. Scheduling of Special Inspection: Coordination of work progress is the responsibility of the contractor. Fire Protection is to remain open for inspection such that the maximum number of installations can be inspected on each visit and number of visits is minimized. Contractor shall notify the Owner and Special Inspector of project readiness and schedule inspections accordingly. The cost of re-inspections for failed fireproofing installation or lack of fireproofing readiness shall be at the expense of the contractor.
- B. Owner shall hire third-party inspector to perform special inspections of installed fireproofing, and inspector shall submit field reports to Contractor and Architect.

1. Testing: All spray-applied fireproofing shall be tested after installation according to ASTM E605/E605M and ASTM E736/E736M, latest editions. Mastics shall be tested in accordance with AWC I Technical Manual 12-B.
 - a. Standard Density SFRM: Minimum bond strength shall be 200 psf when field tested per ASTM E736/E736M.
- C. Provide on-site inspection by applied fireproofing manufacturer's technical representative at least three times (substrate examination, in-progress, and warranty inspection) during installation of this work.
- D. Repair or replace applied fireproofing at testing locations, and at locations where test results indicate fireproofing does not meet specified requirements.
- E. Contractor shall be responsible for subsequent re-inspection of fireproofing, and shall provide periodic inspection for integrity of fire protection after installation of subsequent Work.

3.05 CLEANING

- A. Remove excess material, overspray, droppings, and debris.
- B. Remove fireproofing from materials and surfaces not required to be fireproofed.
- C. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION 078100

**SECTION 078400
FIRESTOPPING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- E. ITS (DIR) - Directory of Listed Products.
- F. SCAQMD 1113 - Architectural Coatings.
- G. FM (AG) - FM Approval Guide.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- I. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Installer's qualification statement.

1.03 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Labeling: Provide permanent labels adjacent to each firestopping assembly. Labels shall be durable metal or plastic and fastened mechanically or with a self-adhering backing. Labels shall include the tested assembly/system number, fire rating of the adjacent building element/ firestopping, the firestopping installer and certification, date of installation, and specific instructions to "Do Not Disturb" and "Alert Building Personnel of Damage."
 - 1. Coordinate with Division 09 "Painting" for stenciled painted labeling of fire-rated walls and partitions.
- C. Installer Qualifications: Company specializing in performing the work of this section and trained/certified by firestopping manufacturer.

1.04 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days

after installation of materials.

- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products.
 - 2. A/D Fire Protection Systems Inc.
 - 3. Hilti, Inc.
 - 4. RectorSeal, a CSW Industrials Company.
 - 5. Specified Technologies Inc.
 - 6. Tremco Commercial Sealants & Waterproofing.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- C. Low-Emitting Materials:
 - 1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
 - 2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - 1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated, but not less than 1 hour.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Air Leakage (Smoke Barriers): Provide systems that have been tested to show L Rating of no more than 5.0 cfm/sq. ft., both at ambient and elevated 400 deg F temperatures.

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.
 1. Coordinate with Division 09 Painting contractor to ensure that all fire-rated walls and partitions are properly labeled.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

SECTION 078426
THERMAL BARRIERS FOR PLASTICS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- F. ITS (DIR) - Directory of Listed Products.
- G. FM (AG) - FM Approval Guide.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- I. UL (FRD) - Fire Resistance Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section. Include other relevant installers including installers of any foam plastic materials over which thermal barriers are to be installed.

1.03 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Product Test Reports: Provide test data indicating compliance with both Temperature Transmission Test and Integrity Fire Test.
- C. Evaluation/Compatibility Reports: Provide data indicating tested compatibility with submitted foam plastic material, for each assembly required.
- D. Installer's qualification statement.
- E. Inspection Reports: Provide inspection reports certified by thermal barrier manufacturer's technical representative, indicating that thermal barrier has been installed in accordance with manufacturer's requirements.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide assemblies that provide 15-minute thermal barrier protection when tested in accordance with both the Temperature Transmission Fire Test and the Integrity Fire Test required by NFPA 275.
 - 1. Temperature Transmission Test: The thermal barrier product shall be tested for standard fire exposure in accordance with ASTM E 119 or ANSI/UL 263.
 - 2. Integrity Fire Test: The thermal barrier assembly, including the specific thermal barrier and foam plastic products submitted for this project, shall be tested as an assembly in accordance with NFPA 276, FM 4880, ANSI/UL 1040, or ANSI/UL 1715.
 - 3. Evidence of passing both test requirements shall be required.
 - a. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

- b. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - c. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Surface-Burning Characteristics: Thermal barrier product shall be tested in accordance with ASTM E 84 and shall be rated for plenum exposure with maximum flame-spread index of 25 and maximum smoke-developed index of 50.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
- 1. Trained, certified, or licensed in writing by manufacturer.
- D. Manufacturer's Inspection: Manufacturer's technical representative shall inspect foam plastic substrates prior to installation and in-progress work to ensure compliance with manufacturer's requirements, and shall provide inspection reports after each visit.
- 1. Thermal barrier installer shall coordinate with manufacturer to provide anticipated installation dates.

1.05 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermal Barrier Manufacturers and Products:
 - 1. Cementitious SFRM Thermal Barrier for Cellular Foam:
 - a. Grace, W.R. & Co.; Monokote Z-3306 Series.
 - b. Southwest Fireproofing Products, Inc.; 7TB Thermal Barrier.
 - 2. Fire-Resistive, Water-Based, Intumescent Mastic Coating for Cellular Foam:
 - a. Thermal Product Research (TPR²); Fireshell.
 - b. Flame Seal Products, Inc.; Flame Seal TB.
 - c. International Fireproof Technology, Inc.; DC315.
 - 3. Cellulose SFRM Thermal Barrier for Cellular Foam:
 - a. International Cellulose Corp.; Ure-K.

2.02 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealants, and other accessory materials as required by manufacturer, that are compatible with the other materials in the thermal barrier assembly and that maintain the thermal barrier rating of the assembly.
- B. Mold and Mildew Resistance: Provide thermal barrier and accessory materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed thermal barriers until special inspections are complete.
- C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Special Inspections: Inspection agency employed and paid by Owner, will examine all spray-applied fireproofing, including thermal barriers, in accordance with the IBC edition applicable to this Project.
 - 1. Testing Services: All fireproofing/thermal barriers shall be tested according to ASTM E 605 and ASTM E 736. Mastics shall be tested according to AWCI 12-B.
- B. Repair or replace spray-applied fireproofing and thermal barriers at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

- A. Clean adjacent surfaces of thermal barrier overspray; clean all adjacent surfaces after application.

3.06 PROTECTION & REPAIR

- A. Protect adjacent surfaces from damage by material installation.
- B. If installed thermal barrier must be cut due to subsequent penetrations or other work, provide additional patching work as required to restore thermal barrier to a continuous, complete assembly at the time of Substantial Completion.
- C. Repair damage to thermal barriers caused by construction activities; verify that repaired work maintains a continuous, complete thermal barrier assembly.

END OF SECTION 078426

**SECTION 079200
JOINT SEALANTS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- C. ASTM C834 - Standard Specification for Latex Sealants.
- D. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- E. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- I. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- J. ASTM C1311 - Standard Specification for Solvent Release Sealants.
- K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- L. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- M. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.
- N. SCAQMD 1113 - Architectural Coatings.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include 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.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

- F. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- G. Executed warranty.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section, and is approved and/or certified by manufacturer.
- B. 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 sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- C. 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. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
 - a. Test date.
 - b. Copy of test method documents.
 - c. Age of sealant upon date of testing.
 - d. Test results, modeled after the sample form in the test method document.
 - e. Indicate use of photographic record of test.
- D. 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. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
 - 6. 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.
- E. 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 before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or

installation procedures.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 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:
 - 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. Wall and ceiling joints.
 - c. Joints between plumbing fixtures and floor or wall construction.
 - d. Other joints indicated below.
 - 3. Do not seal the following types of joints:
 - a. Intentional weep holes 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: Use non-sag non-staining silicone sealant (ES-1), unless otherwise indicated.
 - 1. Type ES-5 - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
 - 2. Type ES-1 or ES-2 - Joints between walls and frames of doors, windows, and louvers.
 - 3. Type SRS-1 - Bedding joints.
- C. Interior Joints: Use non-sag polyurethane sealant (ES-4), unless otherwise indicated.
 - 1. Type ES-3 - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - 2. Type ES-5 - Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
 - 3. Type AS-1 - Joints at sound-rated or acoustic assemblies, and at full-height panel wall and partition assemblies indicated to have sound attenuation batts.
 - 4. Type LS-1 - Joints around perimeters of interior doors, windows, elevator entrances, and similar framed openings.

- D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.
- F. Areas Where Tamper- or Pick-Resistance is Required: Within the secure area designated on the Drawings.
 - 1. Security Sealants shall be used at all construction joints in detainee holding and transport areas and areas indicated as I-3 Use Group areas. Joints above ceilings, covered by expansion joints, or otherwise concealed are excluded.
 - 2. Provide "tamper-resistant" security sealants for supervised areas (corridors, interview rooms, etc.) and "pick-resistant" security sealants for areas not subject to continuous supervision (holding cells). Do not use pick-resistant epoxy in building joints such as control or expansion joints; use tamper-resistant polyurethane at these locations.
 - a. Provide tamper resistant polyurethane for all exposed voids between finish materials, and between finish materials and surface mounted devices that inmates could use to hide contraband in inmate-accessible rooms inside the secure perimeter. Provide also at flooring terminations to walls where no base is scheduled (or painted base only), and at joints between ceilings and walls.
 - 3. Refer to Security and Security Access Control specifications (Divisions 11 and 28) for additional references and requirements for security sealants.

2.02 JOINT SEALANTS - GENERAL

- A. Low-Emitting Materials:
 - 1. Paints and Coatings: Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.
 - 2. Adhesives and Sealants: Adhesives and sealants field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet the chemical content requirements of SCAQMD 1168.

2.03 NONSAG JOINT SEALANTS

- A. Type ES-1 - Low-Modulus 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. Nonstaining to Porous Stone: Nonstaining 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 full range.
 - 5. Products:
 - a. Master Builders Solutions; MasterSeal NP 100.
 - b. Momentive Performance Materials, Inc/GE Silicones; SCS 2000 SilPruf.
 - c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology) or 890 FST (Field Tint).
 - d. Polymeric Systems, Inc.; PSI-641.
 - e. Tremco Commercial Sealants & Waterproofing; Spectrem 3 or Spectrem 4-TS (Field Tint).
 - f. Substitutions: See Section 016000 - Product Requirements.
- B. Type ES-2 - Medium-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

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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 full range.
 5. Manufacturers:
 - a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
 - b. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant.
 - c. Pecora Corporation; Pecora 895 NST (Non-Staining Technology).
 - d. Tremco Commercial Sealants & Waterproofing; Spectrem 2.
 - e. Substitutions: See Section 016000 - Product Requirements.
- C. Type ES-3 - 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. Neutral- or acid-curing per manufacturer standard.
1. Color: White.
 2. Products:
 - a. Dow; DOWSIL 786 Mildew Resistant.
 - b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology).
 - c. Tremco Commercial Sealants & Waterproofing; Tremsil 600 or Tremsil 200.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Type ES-4 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; multi-component; 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 full range.
 3. Products:
 - a. ITW Polymers Sealants; Permthane SM 7200.
 - b. Master Builders Solutions by BASF; MasterSeal NP2.
 - c. Pecora Corporation; DynaTrol II.
 - d. Sika Corporation; Sikaflex-2c NS.
 - e. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC or Vulkem 227.
 - f. Substitutions: See Section 016000 - Product Requirements.
- E. Security Sealant - "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: Plus and minus 12-1/2 percent, minimum.
 2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.
 3. Products:
 - a. Master Builders Solutions; MasterSeal CR 195.
 - b. Pecora Corporation; DynaFlex SC.
 - c. Sika Corp; Sikaflex 11 FC.
- F. Security Sealant - "Pick-Resistant" Epoxy Sealant: ASTM C881/C881M, Type I and III, Grade 3, Class B and C; two-component.
1. Hardness Range: 65 to 75, Shore D, when tested in accordance with ASTM C661.
 2. Products:

- a. Euclid Chemical; Dural 452 Gel.
 - b. Pecora Corporation; DynaPoxy EP-1200 Two-Part Epoxy Security Sealant.
 - c. Sika Corp; Sikadur 23.
 - d. Substitutions: See Section 016000 - Product Requirements.
- G. Type LS-1 - 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 full range.
 - 2. Grade: ASTM C834; Grade NF.
 - 3. Products:
 - a. Bostik, Inc; Chem-Calk 600.
 - b. ITW Polymers Sealants; SM 8200.
 - c. Master Builders Solutions; MasterSeal NP 520.
 - d. Pecora Corporation; AC-20 +Silicone.
 - e. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
 - f. Substitutions: See Section 016000 - Product Requirements.
- H. Type AS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging acoustical sealant.
- 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 - 2. Grade: ASTM C834; Grade NF.
 - 3. Manufacturers:
 - a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
 - b. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant.
 - c. Hilti, Inc; CP 506 Smoke and Acoustical Sealant.
 - d. Master Builders Solutions; MasterSeal NP 520.
 - e. Momentive Performance Materials, Inc/GE Silicones; RCS20 Acoustical.
 - f. Pecora Corporation; AC-20 FTR or AIS-919.
 - g. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant.
 - h. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound.
 - i. Substitutions: See Section 016000 - Product Requirements.
- I. Type SRS-1 - Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
- 1. Products:
 - a. Bostik, Inc; Chem-Calk 300.
 - b. Pecora Corporation; Pecora BC-158 Butyl Rubber Sealant.
 - c. Tremco Inc.; Tremco Butyl Sealant.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 SELF-LEVELING JOINT SEALANTS

- A. Type ES-5 - Self-Leveling Polyurethane Sealant for Traffic: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure.
- 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Products:
 - a. Bostik, Inc.; Chem-Calk 550.

- b. ITW Polymers Sealants; Permthane SM 7201.
- c. Pacific Polymers, Inc; Elast-Thane 227 Type 1 (Self-Leveling).
- d. Polymeric Systems, Inc; PSI-270SL.
- e. Tremco Commercial Sealants & Waterproofing; THC-901 or THC-900.
- f. W. R. MEADOWS, Inc; POURTHANE SL.
- g. Substitutions: See Section 016000 - Product Requirements.

2.05 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.
- 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, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. 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. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 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 an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install 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.
- J. Installation of Security Sealants: Install in locations indicated in accordance with manufacturer's written recommendations.
 - 1. Apply pick-resistant non-flexible 95 shore "A" hardness epoxy type security sealant in all spaces and cracks between similar and dissimilar materials including, but not limited to, metal frames, windows, all fixtures except vitreous china plumbing fixtures, detention furniture, embeds, secure air diffusers, lock columns and receivers.
 - 2. Apply tamper resistant flexible 55 shore "A" hardness security sealant in any open joints located in cells, including joints at the intersections of walls to walls, walls to ceilings and walls to floors.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Destructive Adhesion Testing: If there are any failures in first 1,000 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.

END OF SECTION 079200

**SECTION 079513
EXPANSION JOINT COVER ASSEMBLIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products.
- B. UL (DIR) - Online Certifications Directory.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.03 SUBMITTALS

- A. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- C. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal/Resilient Expansion Joint Cover Assemblies:
 - 1. Architectural Art Mfg, Inc.
 - 2. Balco, Inc.
 - 3. Construction Specialties, Inc.
 - 4. Inpro.
 - 5. MM Systems Corp.:
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Preformed Foam Expansion Joint Assemblies:
 - 1. Construction Specialties, Inc.
 - 2. EMSEAL Joint Systems, Ltd.
 - 3. MM Systems Corp.
 - 4. Schul International Company, Inc.
 - 5. Watson Bowman Acme Corp.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. General: Provide 2-inch joint assemblies at all locations, unless otherwise indicated.
 - 1. Color for all joints shall be selected from manufacturer's full range of available colors.

2.03 SECURITY EXPANSION JOINTS

- A. Interior Wall and Floor Joints (Security Preformed Foam): Pick-resistant, pre-coated polyurethane; pre-compressed and self-expanding; 2-hour fire rated. Joint shall allow for minimum 50% total movement (25% expansion, 25% contraction). Provide at interior and

exterior wall joints at secure applications (detainee holding and transport spaces).

1. Products:
 - a. EMSEAL Joint Systems, Ltd.; Emshield SecuritySeal SSW2 (walls) and SSF2 (floors).
 - b. Nystrom; Model PSES2 (walls) and FHES2 (floors).
 - c. Erie Metal Specialties; CSPR-Series (walls and floors).

2.04 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 1. Joint Dimensions and Configurations: As indicated on drawings.
 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Exterior Joints at Cavity/Masonry Veneer Walls: Provide a "double" preformed foam joint at exterior joints, with aesthetic joint at face of veneer masonry, and a functional joint (manufacturer's standard neutral color) in the plane of insulation to maintain continuity of insulation and water and air barriers.
- C. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- D. Covers in Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.
 1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION 079513

**SECTION 081113
STEEL DOORS AND FRAMES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames.
- D. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

1.02 SUBMITTALS

- A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.03 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

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company.
 - 2. Curries, an Assa Abloy Group company.
 - 3. Fleming Door Products, an Assa Abloy Group company.
 - 4. Krieger Specialty Products.
 - 5. Mesker, dormakaba Group.
 - 6. Metal Products, Inc. (MPI)
 - 7. Pioneer Industries, Inc.; an Assa Abloy Group company.
 - 8. Republic Doors, an Allegion brand.
 - 9. Steelcraft, an Allegion brand.
 - 10. Technical Glass Products.

2.02 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. Door Top and Bottom Closures: Flush end closure channel, with top and door faces aligned.
 - a. Inverted channel closure is acceptable for bottom edges and top edges of interior doors that are not exposed to view from above.
 4. Door Edge Profile: Beveled edge.
 5. Typical Door Face Sheets: Flush.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
 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 (galvannealed) 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 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) 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.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated. Fabricate from metallic-coated steel sheet.
 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 gauge, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 2. Door Core Material: Vertical steel stiffeners with fiberglass batts.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Door Thermal Resistance: R-Value of 6, minimum.
 4. Door Thickness: 1-3/4 inches, nominal.
 5. Weatherstripping: Refer to Division 08 "Door Hardware".
- C. Interior Doors, Non-Fire-Rated: Fabricate from either cold-rolled steel sheet or metallic-coated steel sheet.
 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 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements, except kraft paper honeycomb core is not acceptable.
3. Door Thickness: 1-3/4 inches, nominal.
- D. Fire-Rated Doors: Comply with NFPA 80.
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Match construction and physical performance levels above for interior or exterior doors, as applicable.
 2. Fire Rating: As indicated, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 3. Per NFPA 80, fire exit doors shall be labeled "Fire Door to Be Equipped with Fire Exit Hardware," and shall be reinforced and constructed to maintain the rating of the specific listed and labeled fire exit devices mounted on them.
 4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 6. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
 - B. Frame Finish: Factory primed and field finished.
 - C. Exterior Door Frames: Face welded type.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 3. Weatherstripping: Refer to Division 08 Section "Door Hardware".
 - D. Interior Door Frames, Non-Fire Rated: Face welded type.
 1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - E. Door Frames, Fire-Rated: Face welded type.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
 - G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
 1. Where removable mullion is indicated, coordinate with removable mullion to be provided as an exit device accessory per Division 08 Section "Door Hardware."
 - H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
 - I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 - J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
 - K. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
-

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 - 1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
 - 2. Style: Sightproof inverted V- or Y-blade.
 - 3. Fasteners: Exposed or concealed fasteners.
- B. Glazing: As specified in Section 088000.
- C. Removable and Fixed Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
 - 1. Provide fixed stops for exterior applications, and toward the secure side of interior glazed lites (for example, toward the corridor or more public accessible spaces).
 - 2. Heights of Stops: Unless otherwise indicated or recommended by glazing manufacturer, provide standard 5/8-inch height stops where allowed by standards, and provide 3/4-inch height for exterior 1-inch glazing units.
- D. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
 - 1. Provide UL listed products, complying with NFPA 80, and as required to maintain indicated fire rating.
 - 2. Provide surface mounted overlapping-type astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
- 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

3.01 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.

3.02 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.
 - 1. Install in accordance with ANSI/SDI A250.11.
 - 2. Do not remove temporary frame spreaders until after frames have been properly set and secured.
- B. Install fire rated units in accordance with NFPA 80.

- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.
- F. Comply with glazing installation requirements of Section 088000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.03 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.
 - 1. Comply with clearances indicated in NFPA 80 for fire-rated doors.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

**SECTION 081416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- C. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- D. UL 10B - Standard for Fire Tests of Door Assemblies.

1.02 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- 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.
- C. Selection Samples: Submit manufacturer's color charts indicating full range of available colors, for each product requiring color selection.
- D. Verification Samples: Submit three physical samples of door veneer, approximately 8 by 8 inches in size illustrating standard range of wood grain, stain color, and sheen.
- E. Warranty, executed in Owner's name.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Provide all flush wood doors from a single manufacturer.

1.04 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.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Eggers Industries.
 - 2. Lambton Doors.
 - 3. Masonite Architectural; Aspiro Select Wood Veneer Doors.
 - 4. Oshkosh Door.
 - 5. VT Industries, Inc.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Doors shall be manufactured by the hot-press method, bonding faces, crossbands, and core together in a single operation with Type I glue. Doors manufactured by cold-pressing 2- or 3-ply pre-manufactured door skins to multiple cores in the same press will not be accepted.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. 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.
 - a. Provide stile construction with concealed intumescent seals at pairs of doors, meeting required fire-ratings without the need of astragal or metal edge construction.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), particleboard Grade LD-2 per ANSI A 208.1; plies and faces as indicated.
 - 1. Provide structural-composite-lumber (SCLC) core for doors with glazing area cut out for 9-inch stile width doors.
 - 2. Provide structural-composite-lumber (SCLC) core for doors with exit devices.
- 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.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Select White birch, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. For doors indicated to be factory-finished, factory install glazing in doors in compliance with quality standards specified, using manufacturer's standard elastomeric glazing sealant.
- 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.
- G. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 5, Varnish, Conversion or System 11, catalyzed polyurethane.
 - b. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.
- C. Seal door top edge with color sealer to match door facing where doors will be exposed to view from above.

2.07 ACCESSORIES

- A. Wood Louvers:
 - 1. Material and Finish: Match species of door panels.
- B. Metal Louvers:
 - 1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
 - 2. Louver Blade: Inverted V blade, sight proof, light proof; fire rated to indicated rating, with fusible link designed to UL requirements.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws. At fire-rated doors, provide noncombustible wood stops with concealed metal clips for indicated fire rating.
- D. Door Hardware: Refer to Section 087100.

PART 3 EXECUTION

3.01 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.

3.02 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.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 081416

**SECTION 083100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products.
- B. UL (FRD) - Fire Resistance Directory.

1.02 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
 - 1. Include a schedule indicating wall/ceiling type, door types, sizes, and hardware for each access door required.

1.03 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.
 - 1. This (083100) material specification includes access doors required for Divisions 21 (Fire Suppression), Division 22, (Plumbing), 23 (HVAC) and Division 26 (Electrical) work and any other access doors indicated on Drawings.

PART 2 PRODUCTS

2.01 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. ACUDOR Products Inc.
 - 3. Babcock-Davis.
 - 4. Best Access Doors.
 - 5. Cendrex, Inc.
 - 6. Karp Associates, Inc.
 - 7. Larsen's Manufacturing Company.
 - 8. Milcor, Inc.
 - 9. Nystrom, Inc.
 - 10. Williams Brothers Corporation of America.
 - 11. Substitutions: See Section 016000 - Product Requirements.
- B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Material: Steel.
 - 2. Style (Gypsum Board locations): Recessed door panel for infill with wall/ceiling finish.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 3. Style (Masonry locations): Exposed frame, with door surface flush with frame surface.
 - 4. Door Style: Double-skinned hollow panel.

5. Frames: 16-gauge, 0.0598-inch minimum thickness.
6. Double-Skinned Hollow Steel Sheet Door Panels: 16-gauge, 0.059-inch minimum thickness, on both sides and along each edge.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 - c. Fire-rated door assemblies shall conform with and be installed in accordance with (1) NFPA 80, (2) door and frame manufacturer's installation instructions, and (3) listing requirements of qualified testing agency.
8. Steel Finish: Primed.
9. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 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.

END OF SECTION 083100

**SECTION 083313
COILING COUNTER DOORS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- E. UL (DIR) - Online Certifications Directory.
- F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include electrical data for fire release mechanism.
- B. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- C. Samples: Submit manufacturer's color charts indicating standard range of powder coat finishes.
- D. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.
- E. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.
- F. Warranty: Provide executed warranty, completed in Owner's name.

1.03 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.04 WARRANTY

- A. Refer to Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer Warranty: Provide two-year manufacturer warranty for materials and workmanship for all components of coiling doors. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coiling Counter Doors:
 - 1. Alpine Overhead Doors, Inc.
 - 2. Amarr.
 - 3. C.H.I. Overhead Doors.
 - 4. Clopay Building Products.
 - 5. Cornell Iron Works, Inc.

6. Hörmann High Performance Doors.
7. McKeon Rolling Steel Door Co., Inc.
8. Overhead Door Corporation.
9. Raynor Garage Doors.
10. The Cookson Company.
11. Wayne-Dalton, a Division of Overhead Door Corporation.
12. Substitutions: See Section 016000 - Product Requirements.

2.02 COILING COUNTER DOORS

- A. Coiling Counter Doors, Non-Fire-Rated: Galvanized steel slat curtain.
 1. Mounting: Face of wall mounted (mount on non-secure/non-public side).
 2. Nominal Slat Size: Manufacturer's standard.
 3. Slat Profile: Flat.
 4. Finish, Galvanized Steel: Factory powder coated.
 5. Color: As selected by Architect from manufacturer's standard range.
 6. Guides: Formed track; same material and finish unless otherwise indicated.
 7. Hood Enclosure: Manufacturer's standard; galvanized steel. Finish to match slats.
 8. Manual push up operation.
 9. Locking Device: Slide bolt for padlock (padlocks NIC).
 10. Integral Counter/Sill: Not required. Coordinate coiling door height so that doors will close to the top of indicated stainless steel detention counters.
- B. Coiling Counter Doors, Fire-Rated: Galvanized steel slat curtain.
 1. Location: Provide where coiling counter door is indicated in fire-rated wall or partition.
 2. Mounting: Face of wall mounted as indicated below:
 - a. At windows AM104B and AM104C: Mount on Magistrate side.
 - b. At window IP108C: Mount on Booking side.
 3. Fire Rating: 3/4 hour at windows AM104B and AM104C; and 1/3 hour at window IP108C. Comply with NFPA 80.
 - a. Provide product listed and labeled by UL (DIR) as suitable for the purpose specified and indicated.
 4. Smoke Control: Provide doors tested to UL 1784, with maximum air-leakage rate of 3.0 cfm/sq. ft. at 0.10-inch wg. Doors shall be listed and labeled by UL (DIR) with letter "S" designating smoke-control.
 5. Nominal Slat Size: Manufacturer's standard.
 6. Slat Profile: Flat.
 7. Finish, Galvanized Steel: Factory powder coated.
 8. Color: As selected by Architect from manufacturer's standard colors.
 9. Guides: Formed track; same material and finish unless otherwise indicated.
 10. Hood Enclosure: Manufacturer's standard; galvanized steel. Finish to match slats.
 11. Fire Release Mechanism: Automatic door release device, actuated by fire alarm and smoke detection systems, with manual reset.
 12. Integral Counter/Sill: Not required. Coordinate coiling door height so that doors will close to the top of indicated counters.

2.03 MATERIALS

- A. Curtain Construction: Interlocking, single thickness slats.
-

1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position; neoprene astragal along bottom edge.
 3. Steel Slats: ASTM A653/A653M galvanized steel sheet, with minimum G90/Z275 coating; minimum thickness 16 gauge, 0.06 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
1. Guides for Galvanized Curtains: ASTM A36/A36M steel angles, size as indicated, hot-dip galvanized per ASTM A123/A123M.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
1. Include automatic hood baffle on fire-rated doors to prevent smoke or fire penetration at hood.
- D. Lock Hardware:
1. For fire shutter units, additional lock or latching mechanisms are not required.
 2. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
- E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.
1. Provide fire-rated doors with auxiliary counterbalance spring to allow for operation of fire release mechanism without tension release of main counterbalance spring.
- F. Smoke Seals/Gasketing: Provide fire-rated doors with continuous smoke seal gaskets around perimeter of door in accordance with requirements of UL-tested and -listed assembly.

2.04 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction (AHJ) as suitable for purpose specified and indicated.
1. Fire Release Mechanism: Provide fire-rated door with a constantly energized release device with governor unit and battery backup; complying with NFPA 80; 110/120V. Release device shall be designed to activate upon fire-alarm or smoke-detection system activation. Connection and wiring of release device to fire-alarm and smoke-detection system shall be by Division 26.
 - a. Release device shall allow for testing and manual resetting without retensioning the counterbalance spring system.
 - b. Release device shall have replaceable fusible link above the door designed to activate release at 165 degrees F, as backup in the event of fire-alarm/smoke-detection failure.
 - c. Provide additional mounting hardware and accessories as required for a complete assembly.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install fire-rated doors in accordance with NFPA 80.
- C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- F. Coordinate installation of electrical service with Division 26, including wiring from fire-alarm and smoke-detection systems.
- G. Complete wiring from disconnect to unit components.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION 083313

**SECTION 083323
OVERHEAD COILING DOORS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ITS (DIR) - Directory of Listed Products.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- G. NEMA MG 1 - Motors and Generators.
- H. UL (DIR) - Online Certifications Directory.
- I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.02 SUBMITTALS

- A. Product Data: Provide general construction, electrical equipment, and component connections and details.
 - 1. Include product data for door position switches.
 - 2. Include product data for automatic closing device for fire shutter application, with testing and resetting instructions.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
 - 1. Include diagrams indicating motors, controls, and electrical wiring.
 - 2. Indicate coordination with smoke and/or fire alarm systems, and show locations of detectors, replaceable fusible links, and release devices.
 - 3. Indicate locations of door position switches.
- C. Selection Samples: Manufacturer's color charts, showing full range of factory finishes.
- D. Verification Samples: Manufacturer's standard size sample on curtain slat material indicated.
- E. Installer's qualification statement.
- F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified, approved by manufacturer for installation of specified products. Installer shall be located no more than two hours from Project site to allow for maintenance callbacks.
- B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified and indicated.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide two-year manufacturer warranty for materials and workmanship for all components of coiling doors. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Alpine Overhead Doors, Inc.
 - 2. Amarr.
 - 3. C.H.I. Overhead Doors.
 - 4. Clopay Building Products.
 - 5. Cornell Iron Works, Inc.
 - 6. Hörmann High Performance Doors.
 - 7. McKeon Rolling Steel Door Co., Inc.
 - 8. Overhead Door Corporation.
 - 9. Raynor Garage Doors.
 - 10. The Cookson Company.
 - 11. Wayne-Dalton, a Division of Overhead Door Corporation.
 - 12. Substitutions: See Section 016000 - Product Requirements.

2.02 COILING DOORS

- A. Exterior Coiling Doors: Steel slat curtain.
 - 1. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.
 - 2. Sandwich Slats: Manufacturer's standard, with core of foamed-in-place polyurethane insulation; minimum R-value of R-6.
 - a. Surface Burning Characteristics: Provide insulation with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 3. Slat Size: Manufacturer's standard height and thickness to meet performance requirements; length as required for rough opening width indicated.
 - 4. Guide, Angles: Powder coated steel.
 - 5. Hood Enclosure: Manufacturer's standard; powder coated steel.
 - 6. Electric operation.
 - 7. Mounting: Surface mounted.
 - 8. Locking Devices: Slide bolt on inside, with padlock hasp (Padlock NIC).
 - 9. Finish: As selected by Architect from manufacturer's full range of powder coat finishes.
- B. Interior Non-Fire-Rated Coiling Doors: Steel slat curtain.
 - 1. Location: Provide at control room window between control room and female housing units. Control station shall be mounted within control room; confirm final location with Architect.
 - 2. Single Thickness Slats: Manufacturer's standard.
 - 3. Slat Size: Manufacturer's standard height and thickness to meet performance requirements; length as required for rough opening width indicated.

4. Guides, Angles: Powder coated steel.
5. Hood Enclosure: Manufacturer's standard; powder coated steel.
6. Electric operation.
7. Mounting: Surface mounted.
8. Locking Devices: Not required.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 1. Curtain Bottom for Slat Curtains: Fitted with steel angles to provide reinforcement and positive contact in closed position; powder coated to match curtain slats.
 2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
 3. Steel Slats: Minimum thickness, 22 gauge, 0.0299 inch; ASTM A653/A653M galvanized steel sheet.
 - a. Galvanizing: Minimum G90 coating.
- B. Guide Construction: Continuous, of profile to retain door in place, mounting brackets of same metal.
- C. Guides - Angle: Two ASTM A36/A36M metal angles, size as required for wind loading, but not less than 1-1/2 by 1-1/2 by 1/8 inch.
 1. Powder coated to match curtain slats.
- D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
 1. Powder coated to match curtain slats.
- E. Lock Hardware:
 1. For motor operated units, additional lock or latching mechanisms are not required.
 2. Latch Handle: Manufacturer's standard.
 3. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
- F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 1. Mounting: Side mounted.
 2. Motor Enclosure:
 - a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.
 - b. Interior Coiling Doors: NEMA MG 1, Type 1; open drip proof.
 3. Motor Rating: 1/2 HP; continuous duty.
 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 6. Controller Enclosure: NEMA 250, Type 4.
 7. Brake: Manufacturer's standard type, activated by motor controller.
 8. Manual override in case of power failure.

- C. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for operators at Loading Dock and Judge's Parking overhead doors. Provide key-operated 'Open-Close-Stop' control device for operators at all Vehicle Sallyport doors.
 - 1. Surface mounted, at interior door jamb.
 - 2. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide NEMA 4X photo eye sensors as required with momentary-contact control device.
 - 1) Mount primary photo eye sensor no more than 6 inches above finish floor I
 - b. Secondary Device: Provide non-monitored pneumatic sensing edge; may also serve as weatherstripping for bottom of door.
- D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for door installation.
- B. Verify that electrical services have been installed and are accessible.
- C. Verify that door opening is plumb, header is level, and dimensions are correct.
- D. Notify Architect of any unacceptable conditions or varying dimensions.
- E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 260583.
- F. Complete wiring from disconnect to unit components.
- G. Install enclosure and perimeter trim.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.
- B. Adjust seals around entire perimeter to ensure a weather-tight installation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION 083323

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- G. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- J. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- B. 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 design engineer's stamp or seal on shop drawings for attachments and anchors.
- C. Selection Samples: Submit manufacturer's color charts representing manufacturer's full range of available colors, for each type of product required.
- D. Verification Samples: Submit physical samples in manufacturer's standard size indicating actual panel material and selected colors, for each type of product required.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

- G. Designer's qualification statement.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 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.

1.05 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.

1.06 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.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Material/Labor Warranty: Provide a 2-year material and workmanship warranty, covering failures including but not limited to, structural and performance failures, excessive material deterioration, failure of operating components, and water or air infiltration. Complete forms in Owner's name and register with warrantor.
- C. Finish Warranty: Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum-Framed Storefront - Exterior - Single Thermal Break - Center Set - 2" x 4.5":
 - 1. EFCO Corp; 403T.
 - 2. Kawneer North America; 451T.
 - 3. Oldcastle Building Envelope; 3000 Thermal.
 - 4. Tubelite, Inc; T14000 Thermal.
 - 5. YKK AP America, Inc; YES 45 TU.
- B. Aluminum-Framed Storefront - Interior - Non-Thermal - Center Set - 2" x 4.5":
 - 1. EFCO Corp; 402.
 - 2. Kawneer North America; Trifab VG 451.
 - 3. Oldcastle Building Envelope; FG 3000.
 - 4. Tubelite, Inc; E14000 Non-Thermal.
 - 5. YKK AP America, Inc; YES 45 FI.
- C. Aluminum-Framed Entrances - Heavy-Duty 2-inch Thick - Insulated - Wide-Stile:
 - 1. EFCO Corp; D518 Durastile.
 - 2. Kawneer North America; 500 Heavy Wall Entrance.
 - 3. Oldcastle Building Envelope; Rugged Entrance.

4. Tubelite, Inc; Monumental Wide Stile Doors.
5. YKK AP America, Inc; 50M.

2.02 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Glazing Position: Centered (front to back).
 2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
 1. 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.
 - a. Design Wind Loads: Comply with requirements of ASCE 7 and as indicated on Structural drawings.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf.
 3. 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.
 4. 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.
 5. Condensation Resistance Factor of Framing: 56, minimum, measured in accordance with AAMA 1503.
 6. Overall U-value Including Glazing: 0.38 Btu/(hr sq ft deg F), maximum.
 7. Solar Heat Gain Coefficient (SHGC) Including Glazing: 0.25, maximum, measured in accordance with NFRC 200.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
-

- B. Glazing: Refer to Section 088000.
- C. Swing Doors: Glazed aluminum.
 - 1. Thickness: 2 inches.
 - 2. Top Rail: 7 inches wide.
 - 3. Vertical Stiles: 5 inches wide (wide stile).
 - 4. Bottom Rail: 12 inches wide.
 - 5. Glazing Stops: Beveled.
 - 6. Finish: Same as storefront.

2.04 MATERIALS AND ACCESSORIES

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Metal Extrusions and Accessories:
 - 1. Metal Trim, Filler, and Closures (Brake Metal): Form interior filler panels for closing ends of partition systems, concealing adjacent structural elements, and for other applications as indicated on Drawings. Form from minimum 0.050-inch aluminum sheet coil, producing a panel of same thickness as partitions or mullions unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces. Finish trim to match storefront unless otherwise indicated.
 - 2. Offset Anchorage System: Provide frame anchorage incorporating L-shaped offset anchors and finished extruded interlocking L-shaped cover trim matching storefront framing. Anchorage "clip and cover" system shall be engineered by storefront manufacturer.
 - 3. Enhanced (High Performance) Sill Flashing: Provide thermally-broken extruded aluminum sill flashing with 2-inch tall back leg and bottom profile with outboard trough and weep holes to direct water to exterior. Provide full-frame-depth end dams mechanically attached to sill flashing extrusion and sealed with silicone. Provide silicone sill flashing splice sleeves and sealant as required at end dams and penetrations for anchorage. Provide finish to match framing.
- D. Sill Flashing Sealant: Elastomeric silicone; compatible with flashing material.
- E. Sealant for Setting Thresholds: Non-curing butyl type.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: To be selected by Architect from manufacturer's full range.

2.06 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: Refer to Section 087100.
- 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 exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 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 water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install glass using glazing method required to achieve performance criteria; see Section 088000.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 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.

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 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.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

SECTION 084413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- B. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift.
- C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- J. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- K. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- M. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
- N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.03 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- C. Selection Samples: Submit manufacturer's color charts representing manufacturer's full range of available colors, for each type of product required.
- D. Verification Samples: Submit physical samples in manufacturer's standard size indicating actual panel material and selected colors, for each type of product required.

- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
- G. Designer's Qualification Statement.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

1.05 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.

1.06 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.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Material/Labor Warranty: Provide a two (2) year material and workmanship warranty, covering failures including but not limited to, structural and performance failures, excessive material deterioration, failure of operating components, and water or air infiltration. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glazed Aluminum Curtain Wall - Exterior - Aluminum Pressure Plates - Front Set - 2.5" x 6":
 - 1. EFCO Corp; 5600.
 - 2. Kawneer North America; 1600 System 1.
 - 3. Oldcastle Building Envelope; Reliance Thermal.
 - 4. Tubelite, Inc; 400CW Curtainwall.
 - 5. YKK AP America, Inc; YCW 750.
- B. Aluminum-Framed Entrances - Heavy-Duty 2-inch Thick - Insulated - Wide-Stile:
 - 1. EFCO Corp; D518 Durastile.
 - 2. Kawneer North America; 500 Heavy Wall Entrance.
 - 3. Oldcastle Building Envelope; Rugged Entrance.
 - 4. Tubelite, Inc; Monumental Wide Stile Doors.
 - 5. YKK AP America, Inc; 50M.

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
 - 2. Fabrication Method: Field fabricated stick system.
 - 3. Glazing Method: Field glazed system.
 - 4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 7. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
 - 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 - 1. Design Wind Loads: Comply with the requirements of ASCE 7 and as indicated on Structural drawings.
 - a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
 - b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
 - 2. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
 - 3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
- D. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 - 1. Test Pressure Differential: 12 psf.
 - 2. Test Method: ASTM E331.

- E. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.
- F. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.
- G. Thermal Performance Requirements:
 - 1. Condensation Resistance Factor of Framing: 56, minimum, measured in accordance with AAMA 1503.
 - 2. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.
 - 3. Solar Heat Gain Coefficient Including Glazing: 0.25, maximum, measured in accordance with NFRC 200.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Cross-Section: As indicated on drawings. Where not indicated, provide 2.5 inch by 6 inch members.
 - 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: Refer to Section 088000.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Structural Steel Sections (Reinforcing): ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- C. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
- E. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness or sheet aluminum, 22 gauge, 0.026 inch minimum thickness.
- F. Firestopping: Refer to Section 078400.
- G. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
- H. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.
- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- J. Glazing Accessories: Refer to Section 088000.
- K. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

- A. Install curtain 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 water tight dam.
- G. Install firestopping at each floor slab edge in accordance with tested assembly.
- H. Pressure Plate Framing: Install glazing and infill panels using exterior dry glazing method; see Section 088000.
- I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet noncumulative or 0.5 inches per 100 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

- A. Provide services of curtain wall manufacturer's technical representative to inspect for proper installation of system and submit report.

3.05 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, take care to remove dirt from corners, and wipe surfaces clean.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084413

**SECTION 085653
SECURITY WINDOWS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. 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.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- E. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- F. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- H. SSPC-Paint 33 - Coal Tar Mastic Coating, Cold-Applied.
- I. UL (DIR) - Online Certifications Directory.
- J. UL 752 - Standard for Bullet-Resisting Equipment.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Furnish anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, to be embedded into concrete or masonry, with setting diagrams and installation, to applicable installer in time for installation.
- B. Preinstallation Meeting: Prior to start of installation arrange a meeting on site to familiarize installer and installers of related work with requirements relating to this work.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's published data showing materials, construction details, dimensions of components, and finishes.
- B. Shop Drawings: Drawings prepared specifically for this project, showing plans, elevations, sections, details of construction, anchorage to other work, hardware, and glazing.
 - 1. For existing and in-place openings show verified field dimensions.
 - 2. Show required opening dimensions and allowance for field deviation.
- C. Test Reports: Test reports for specific window model and glazing to be furnished, showing compliance with specified requirements; window and glazing may be tested separately, provided window test sample adequately simulates the glazing to be used.
 - 1. Include testing agency qualifications.
 - 2. For structural, forced entry, and ballistic tests, provide details on method of anchorage to test frame.

3. Reports for thermal requirements may be based on calculations, in accordance with the specified standard.
- D. Selection Samples: Color charts for factory finishes.
- E. Verification Samples:
 1. Actual sections of frame members, at least 12 inch long, showing finish, weatherstripping, and fasteners.
- F. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent testing agency able to show experience in conducting tests of the type specified.
- B. Installer Qualifications: Company specializing in performing work of the type specified; certified or approved in writing by security window manufacturer.
- C. Welder Qualifications: Qualified in accordance with AWS procedures for type of welding required.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide manufacturer's warranty agreeing to repair or replace windows and window components that fail within three years after Date of Substantial Completion due to, but not limited to, the following:
 1. Structural failure, failure of welds, and deterioration of metals and finishes beyond that expected under detention use and normal weathering.
 2. Failure of glazing due to excessive deflection of supporting members under wind load.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Security View Windows:
 1. Armortex.
 2. Chicago Bullet Proof Systems.
 3. C. R. Laurence Co., Inc.
 4. Creative Industries, Inc.
 5. Insulgard Security Products.
 6. Krieger Specialty Products.
 7. National Bullet Proof, Inc.
 8. Norshield Security Products.
 9. Overly Door Company.
 10. United States Bullet Proofing.
 11. Substitutions: See Section 016000 - Product Requirements.
- B. Source Limitations: Provide windows from a single manufacturer.

2.02 ASSEMBLIES

- A. Security and Detention Windows:
 1. Dimensions, profiles, features, and performance specified and indicated on drawings are required; do not deviate unless specifically approved by Architect under substitution

- procedures; see Section 016000.
2. Design to fit openings indicated on drawings; design to accommodate deviation of actual construction from dimensions indicated on drawings.
 3. Fabricate frames and sash with corners mitered or coped full depth with concealed welded joints.
 4. Design anchorages to provide performance equivalent to that required for window unit; provide anchorages at least equivalent to those by which the tested units were anchored to the test frame.
 5. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.
 6. Weld components before finishing and in concealed locations, to greatest extent possible; minimize distortion and discoloration of finish; remove residue of welding; grind exposed welds smooth and finish to match.
 7. Label units to indicate which side is which, such as inside/outside or secure/non-secure; use labels that are removable after installation but durable enough not to be lost during delivery, storage, handling, and installation.
- B. Exterior Window Requirements: Comply with following performance requirements as well as other specified criteria.
1. Structural Performance: Capable of withstanding wind loads as specified by code without permanent deformation or breakage of components, when tested in accordance with ASTM E330/E330M.
 2. Deflection of Framing Members Supporting Glass: Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edge to less than 1/175 of their lengths under specified design load.
 3. Air Leakage of Fixed Windows: 0.10 cfm/sq ft maximum leakage for fixed window units when tested at 6.27 psf pressure difference in accordance with ASTM E283/E283M.
 4. Water Penetration: None, when tested in accordance with ASTM E331 at test pressure difference of 2.86 psf.
 5. Thermal Performance: Whole-window U-value of 0.38 Btu/sq ft h degF at 15 mph exterior wind velocity and winter condition temperatures.
 6. Provide thermally improved construction using integral, low conductance thermal barrier in frame and sash members.
 7. Provide weep holes and internal water passages to conduct infiltrated water to exterior.
 8. Provide water shed members where sash frames lap in wrong direction to shed water.
 9. Provide factory-installed weatherstripping on operable sash.

2.03 SECURITY VIEW WINDOWS

- A. Security View Windows: Factory-assembled fixed glazing panel reglazable from secure side without disassembly of frame, with non-removable trim and glazing stops on non-secure side (outside).
1. Glazing: Manufacturer's standard laminated type; kind as required to achieve performance criteria specified.
 - a. Total Thickness: 1- to 1-1/4-inches, as standard with manufacturer to meet performance requirements indicated.
 - b. Tint: Gray.
 - c. Low-E Coating: Provide with low-e coating at exterior window applications to achieve required system thermal performance indicated.
 2. Factory glazed.

3. Framing and Glazing Stops: Formed aluminum-clad steel sheet; fluoropolymer finish.
 - a. Framing Cross Section: 4-1/2-inches deep, with sightline either 2- or 2-1/2-inches, as standard with manufacturer.
4. Ballistic Resistance: UL 752 Level 3 (super-power handgun).
5. Communication: Standard talk-through portal; stainless steel; matching ballistic resistance of window.

2.04 ASSEMBLY COMPONENTS

- A. Formed Steel Framing: ASTM A1008/A1008M, Designation CS (commercial steel), cold-rolled steel sheet; 12 gauge, 0.1046 inch minimum thickness.
- B. Aluminum Framing: ASTM B221 (ASTM B221M) extrusions of alloy and temper selected by manufacturer for strength, corrosion resistance, and finish required; not less than 1/8 inch thick at any location of frame and sash members.
- C. Weeps: Include integral weeps for exterior window framing to drain water to the exterior along horizontal framing members.
- D. Frame Anchors: Mild steel plates, shapes, or bars, concealed in completed construction; provide anchorage devices as necessary to securely fasten windows to adjacent construction; use security fasteners for exposed anchors.
 1. For Setting in Masonry: Minimum 3/16 inch thick angles or plates, minimum 4 inches long with hooked ends, welded to back of window frame.
 2. Provide minimum of two anchors per side of window plus one additional anchor for each 18 inches or fraction thereof more than 36 inches in height or width.
- E. Weatherstripping: Factory installed; molded EPDM or neoprene.
- F. Glazing Seals: Factory installed; molded EPDM or neoprene compressible gaskets and compression strips.
- G. Security Fasteners: Operable only by tools produced by fastener manufacturer or manufacturer's licensee; head style appropriate to installation conditions, strength, and finish of materials being fastened; use countersunk heads wherever possible.
- H. Package Receiver: Through-wall mounted, with hinged doors on each side with interlock device allowing door to be open on only one side at a time. Provide manufacturer's standard hinge and latch hardware, door on exterior (non-secure) side shall have automatic door closer. Provide with mounting flanges for flush appearance to both sides of wall.
 1. Material (Body): Formed 12 gauge sheet steel, prime painted.
 2. Material (Doors): On secure side, formed 16 gauge sheet steel, prime painted. On non-secure side, provide stainless steel door. Both doors shall have UL 752 Level 3 bullet resistant armor.
 3. Operation: Manual.
 4. Dimensions: Minimum of 18 inches by 18 inches; by 18 inch total depth. Provide 4 inch maximum projection on non-secure (lobby) side.
- I. Speaking Aperture Covers: Stainless steel, round, allowing passage of speech at normal volume without distortion; listed and labeled by UL (DIR) as bullet resisting to UL 752, same level as window.
- J. Bituminous Paint: Cold-applied asbestos-free asphalt mastic, complying with SSPC-Paint 33; 30 mils, 0.030 inch minimum thickness per coat.
- K. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.05 FINISHES

- A. Fluoropolymer Finish: Cleaned and pretreated; two coat thermosetting finish containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2604; 1.5 to 2 mils thick, applied in accordance with paint manufacturer's recommendations; medium gloss.
- B. Color: To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that window openings are ready for installation of windows.
- B. Verify that correct embedded anchors are in place and in proper location; repair or replace anchors as required to achieve satisfactory installation.
- C. Notify Architect if conditions are not suitable for installation of windows; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. Install windows in correct orientation (inside/outside or secure/non-secure).
- C. Anchor windows securely in manner so as to achieve performance specified.
- D. Separate metal members from concrete and masonry using bituminous paint.
- E. Separate dissimilar metals, and metal members in contact with concrete and masonry, using bituminous paint.

3.03 ADJUSTING

- A. Adjust operating components for smooth operation while also providing tight fit at contact points and a secure enclosure; lubricate operating hardware.

3.04 CLEANING AND REPAIR

- A. Clean exposed surfaces promptly after installation without damaging finishes.
- B. Remove and replace defective work.

END OF SECTION 085653

SECTION 087100 – DOOR HARDWARE

PART 1 - PRODUCTS

1.1 SCHEDULED DOOR HARDWARE

- A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 2 -

1. MK - McKinney
2. MR - Markar
3. RO - Rockwood
4. SA - SARGENT
5. RF - Rixson
6. NO - Norton
7. PE - Pemko
8. OT - Other
9. SU - Securitron

Hardware Sets

Set: 1.0

1 Continuous Hinge	FM100 EL ETAP	628	MR
1 Exit Device	DG1 55 56 8804	US32D	SA
1 Door Pull	RM3310-12 Mtg-Type 12HD	US32D	RO
1 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Weatherstrip	BY DOOR MANUFACTURER		OT
1 Threshold	171A		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SIGNALS LATCH RETRACTION AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

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Set: 2.0

2 Continuous Hinge	FM100 EL ETAP	628	MR
1 Exit Device	DG1 55 56 AD8610 106	US32D	SA
1 Exit Device	55 56 AD8610 EO	US32D	SA
2 Door Pull	RM3310-24 Mtg-Type 12HD	US32D	RO
2 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Weatherstrip	BY DOOR MANUFACTURER		OT
1 Threshold	171A		PE
2 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
2 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
2 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SIGNALS LATCH RETRACTION AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

Set: 3.0

2 Continuous Hinge	FM100	628	MR
1 Exit Device	DG1 AD8610 106	US32D	SA
1 Exit Device	AD8610 EO	US32D	SA
2 Door Pull	RM3310-24 Mtg-Type 12HD	US32D	RO
2 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Weatherstrip	BY DOOR MANUFACTURER		OT
1 Threshold	171A		PE

Set: 4.0

1 Continuous Hinge	FM100	628	MR
1 Exit Device	DG1 8804	US32D	SA
1 Door Pull	RM3310-12 Mtg-Type 12HD	US32D	RO
1 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Weatherstrip	BY DOOR MANUFACTURER		OT
1 Threshold	171A		PE
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT

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Set: 5.0

1 Continuous Hinge	FM300	630	MR
1 Exit Device	DG1 8804	US32D	SA
1 Door Pull	RM3310-12 Mtg-Type 12HD	US32D	RO
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE

Set: 6.0

1 Continuous Hinge	FM300	630	MR
1 Exit Device	DG1 8804 ETJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT

Set: 7.0

2 Continuous Hinge	FM300	630	MR
1 Exit Device	DG1 MD8606 ETJ	US32D	SA
1 Exit Device	MD8610 EO	US32D	SA
2 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Astragal	18041CNB		PE
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
2 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE
2 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT

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Set: 8.0

1 Continuous Hinge	FM300 EL ETAP	630	MR
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 9.0

1 Continuous Hinge	FM300	630	MR
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
1 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT

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Set: 10.0

2 Continuous Hinge	FM300	630	MR
2 Flush Bolt	555/557	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
2 Surface Closer	CPS7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Astragal	18041CNB		PE
1 Set Weatherstrip	303AS		PE
1 Rain Guard	346C		PE
2 Door Bottom Sweep	3452CNB		PE
1 Threshold	2005AT		PE
2 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT

Set: 11.0

2 Continuous Hinge	FM100 EL ETAP	628	MR
1 Exit Device	DG1 55 56 AD8610 106	US32D	SA
1 Exit Device	55 56 AD8610 EO	US32D	SA
2 Door Pull	RM3310-24 Mtg-Type 12HD	US32D	RO
2 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Set Door Seals	BY DOOR MANUFACTURER		OT
2 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
2 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
2 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

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Set: 12.0

Hinge	TA2714	US26D	MK
1 Exit Device	DG1 8813 ETJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 13.0

Hinge	TA2714	US26D	MK
1 Exit Device	DG1 8804 ETJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 14.0

Hinge	TA2714	US26D	MK
1 Exit Device	DG1 12 8804 ETJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals	S88BL		PE

Set: 15.0

Hinge	T4A3786	US26D	MK
1 Exit Device	DG1 12 NB8713 ETJ	US32D	SA
1 Exit Device	12 NB8710 EO	US32D	SA
2 Surface Closer	PR7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
2 Electromagnetic Holder	990 SERIES	689	RF
1 Set Astragal	18041CNB		PE
1 Set Door Seals	S88BL		PE
1 Hardware	SEE NOTE BELOW		OT

NOTE: DOORS TO BE MONITORED BY BUILDING'S FIRE ALARM SYSTEM.

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Set: 16.0

Hinge	T4A3786	US26D	MK
2 Exit Device	12 NB8710 EO	US32D	SA
2 Surface Closer	PR7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
2 Electromagnetic Holder	990 SERIES	689	RF
1 Set Astragal	18041CNB		PE
1 Set Door Seals	S88BL		PE
1 Hardware	SEE NOTE BELOW		OT

NOTE: DOORS TO BE MONITORED BY BUILDING'S FIRE ALARM SYSTEM.

Set: 17.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

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Set: 18.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Card Reader/Keypad	FURNISHED IN OTHER SECTION		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 19.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

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Set: 20.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 21.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

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Set: 22.0

Hinge	TA2714	US26D	MK
1 Electric Hinge	TA2714 x QC	US26D	MK
1 Electrified Lock	DG1 RX 8271 EJ	US32D	SA
1 Surface Closer	UNI7500 x BRKTS REQ'D	689	NO
1 Set Door Seals	BY FRAME MANUFACTURER		OT
1 ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1 ElectroLynx Harness	QC-C000P x LAR		MK
1 Wiring Diagram	AS REQUIRED		SA
1 Card Reader	FURNISHED IN OTHER SECTION		OT
1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 23.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 24.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals	S773BL		PE
1 Door Bottom	411ARL		PE

Set: 25.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 26.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals	S773BL		PE
1 Door Bottom	411ARL		PE

Set: 27.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 28.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 29.0

Hinge	TA2714	US26D	MK
1 Passage Latch	8215 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 30.0

Hinge	TA2714	US26D	MK
1 Passage Latch w/Indicator	LB V21 8212 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 31.0

Hinge	TA2714	US26D	MK
1 Passage Latch w/Indicator	LB V21 8212 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 32.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	LB 8265 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 33.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	LB 8265 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 34.0

Hinge	TA2314	US32D	MK
1 Privacy Lock	LB V21 8265 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 35.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	LB V21 8265 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 36.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	LB V21 8265 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 37.0

Hinge	TA2714	US26D	MK
1 Privacy Lock	LB V21 8265 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 38.0

Hinge	TA2714	US26D	MK
1 Hotel Lock	DG1 LB V21 8250 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 39.0

Hinge	TA2714	US26D	MK
1 Hotel Lock	DG1 LB V21 8250 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 40.0

Hinge	TA2714	US26D	MK
1 Office Lock	DG1 8205 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 41.0

Hinge	TA2714	US26D	MK
1 Office Lock	DG1 8205 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 42.0

Hinge	TA2714	US26D	MK
1 Office Lock	DG1 8205 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 43.0

Hinge	TA2714	US26D	MK
1 Office Lock	DG1 8205 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 44.0

Hinge	TA2714	US26D	MK
1 Classroom Lock	DG1 8237 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 45.0

Hinge	TA2714	US26D	MK
1 Classroom Lock	DG1 8237 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 46.0

Hinge	TA2714	US26D	MK
1 Classroom Lock	DG1 8237 EJ	US32D	SA
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 47.0

Hinge	TA2714	US26D	MK
1 Classroom Lock	DG1 8237 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 48.0

Hinge	TA2714	US26D	MK
2 Flush Bolt	555/557	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Classroom Lock	DG1 8237 EJ	US32D	SA
2 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 49.0

Hinge	TA2714	US26D	MK
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 50.0

Hinge	TA2714	US26D	MK
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 51.0

Hinge, Spring	1502	US26D	MK
Hinge	TA2714	US26D	MK
1 Storeroom Lock	DG1 8206 EJ	US32D	SA
1 Flush Pull	94L	US32D	RO
1 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 52.0

Hinge	TA2714	US26D	MK
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 53.0

Hinge	TA2714	US26D	MK
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 54.0

Hinge	TA2714	US26D	MK
2 Flush Bolt	555/557	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	DG1 8204 EJ	US32D	SA
2 Overhead Stop	10 SERIES	630	RF
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 55.0

Hinge	TA2714	US26D	MK
1 Set Combo Flush Bolts	2845/2945	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	DG1 8206 EJ	US32D	SA
1 Coordinator	2600 x FILLER BAR x CLOSER MTG BRKTS AS REQ'D	US28	RO
2 Surface Closer	CPS7500	689	NO
2 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Astragal	18041CNB		PE
1 Set Door Seals	S88BL		PE

Set: 56.0

Hinge	TA2714	US26D	MK
1 Push Plate	70F	US32D	RO
1 Pull Plate	BF 111x70C	US32D	RO
1 Surface Closer	7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 57.0

Hinge	TA2714	US26D	MK
1 Push Plate	70F	US32D	RO
1 Pull Plate	BF 111x70C	US32D	RO
1 Surface Closer	PR7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Door Stop	409/441CU	US26D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

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Set: 58.0

Hinge	TA2714	US26D	MK
1 Push Plate	70F	US32D	RO
1 Pull Plate	BF 111x70C	US32D	RO
1 Surface Closer	CPS7500	689	NO
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 59.0

1 Storeroom Lock	DG1 8204 EJ	US32D	SA
1 Hardware	SEE NOTE BELOW		OT

NOTE: CHAIN LINK GATE - BALANCE OF HARDWARE TO BE SUPPLIED BY GATE MANUFACTURER.

Set: 60.0

1 Hardware	SEE NOTE BELOW		OT
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NOTE: OVERHEAD DOOR - ALL HARDWARE TO BE SUPPLIED BY DOOR MANUFACTURER.

Set: 61.0

1 DPDT Door Position Switch	BEA SERIES AS REQUIRED		OT
1 Hardware	SEE NOTE BELOW		OT

NOTE: OVERHEAD DOOR - BALANCE OF HARDWARE TO BE SUPPLIED BY DOOR MANUFACTURER.

END OF SECTION 087100

**SECTION 088000
GLAZING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- K. GANA (GM) - GANA Glazing Manual.
- L. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
- M. NFRC 100 - Procedure for Determining Fenestration Product U-factors.
- N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
- O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

1.02 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.

1.03 SUBMITTALS

- A. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Certificate: Certify that products of this section meet or exceed specified requirements.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and IGMA TM-3000 for glazing installation methods.

1.05 MOCK-UPS

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Integrated Exterior Mockups: Provide glazing to match glazing systems required for Project, including glazing installation methods, for incorporation into integrated exterior mockup as indicated on Drawings and as specified in Division 01 "Quality Requirements."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions. Deliver and store in a manner to prevent exposure to weather/moisture, direct sun/UV, and temperature changes.

1.07 FIELD CONDITIONS

- A. Ambient Conditions: Do not install glazing, gasketing, or liquid sealants under adverse weather conditions, or when temperatures are above or below manufacturer's recommended limitations for sealant installation.
 - 1. Do not install glazing when ambient temperature is less than 40 degrees F.
 - 2. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 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. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Cardinal Glass Industries.
 - 2. Guardian Glass, LLC.
 - 3. Viracon.
 - 4. Vitro Architectural Glass (formerly PPG Glass).

2.02 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 and values indicated on Structural Drawings.
 - 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 complete assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and air barrier.
- 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.

2.03 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. Provide Type I, Quality-Q3, Class 1 (clear) glazing unless otherwise indicated.
 - a. Tinted Glazing: Where tinted glazing is indicated, provide Class 2 (tinted).
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 5. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
 6. Spandrel Glass Type: ASTM C 1048, Type I, Condition - B, Quality - Q3, with performance characteristics matching those of adjacent non-spandrel units.
 7. Patterned Glass Type: ASTM C1048, Type II - Patterned Flat Glass, Quality - Q6, Form 3 - Patterned glass, with color and performance characteristics as indicated.
 - a. "Frosted" Appearance: Provide non-directional acid-etch or simulated acid-etch "frosted"/translucent finish on one or both faces of glass lite.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172. Laminated glass shall be free of foreign substances and air or glass pockets.
 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class A or 16 CFR 1201 - Category II impact test requirements.
 2. Ionoplast Interlayer: 0.060 inch thick, minimum.
 - a. Provide Kuraray "SentryGlas" or comparable ionoplast interlayer submitted as a properly formatted substitution request.
 - b. Color: Clear.
 - c. Interlayer Physical Properties:
 - 1) Young's Modulus:43 kpsi, when tested in accordance with ASTM D5026.
 - 2) Tensile Strength: 5.0 kpsi, when tested in accordance with ASTM D638.
 - 3) Elongation: 400%, when tested in accordance with ASTM D638.
 - 4) Flex Modulus: 50 kpsi, when tested in accordance with ASTM D790.
 - 5) Heat Deflection Temperature at 0.46 MPa: 110 degrees F, when tested in accordance with ASTM D648.

2.04 INSULATING GLASS UNITS

- A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

- B. Insulating Glass Units: Types as indicated. IGU's shall be pre-assembled in factory of multiple lites, with dehydrated interspace.
 - 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: Manufacturer's warm-edge technology design.
 - a. Spacer Width: As required for specified insulating glass unit.
 - b. Spacer Height: Manufacturer's standard.
 - c. Products:
 - 1) H.B. Fuller Construction Products Inc; Kodispace 4SG.
 - 2) Quanex IG Systems, Inc; Super Spacer TriSeal.
 - 3) Technoform Glass Insulation; TGI-Spacer.
 - 4) Substitutions: See Section 016000 - Product Requirements.
 - 4. Spacer Color: Black.
 - 5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 - b. Color: Black.
 - 6. Purge interpane space with dry air, hermetically sealed.

2.05 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option I. 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 I. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. 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.

3.04 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 inch 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.

3.05 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.06 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.

3.07 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.

3.08 GLAZING SCHEDULE

- A. Type G1 - Monolithic Interior Vision Glazing:
 - 1. Applications: Interior glazing unless otherwise indicated.

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2. Glass Type: Fully tempered float glass. Provide with safety glazing labeling.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
 5. Glazing Method: Dry glazing method, gasket glazing.
- B. Type G2 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Gray.
 - b. Coating: Low-E (passive type), on #2 surface.
 - c. Coating Products (Low-E; Gray Tinted):
 - 1) Cardinal; ES 25 Pure Grey #2.
 - 2) Guardian; SN 68 Gray.
 - 3) Viracon; #VE3-2M.
 - 4) Vitro; Solarban 60 (2) Solargray.
 4. Warm-edge spacer.
 5. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 6. Total Thickness: 1 inch.
 7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.30, maximum.
 8. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
 9. Glazing Method: Dry glazing method, gasket glazing.
 10. Provide with safety glazing labeling.
- C. Type G3 - Insulating Glass Units: Spandrel glazing.
1. Applications: Exterior glazing where indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 - c. Coating Products (Clear; Low-E):
 - 1) AGC; Energy Select 28.
 - 2) Cardinal; ES 28 #2.
 - 3) Guardian; SNX 62/27.
 - 4) Viracon; #VNE 1-63.
 - 5) Vitro; Solarban 70.
 4. Warm-edge spacer.
 5. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Opacifier: Ceramic frit, on #4 surface.
 - c. Opacifier Color: Selected by Architect from manufacturer's full range.
 6. Total Thickness: 1 inch.
 7. Thermal (U-Value and SHGC): Match requirements of vision units.
 8. Glazing Method: Dry glazing method, gasket glazing.
 9. Provide with safety glazing labeling.
-

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- D. Type G4 - Ballistic Glazing (Storefront): Refer to Division 11 Section "Security Glass and Glazing" for insulated security glazing type.
- E. Type G4 - Ballistic Glazing (Security Windows): Refer to Section 085653 - Security Windows for manufacturer's standard ballistic rated glazing provided with fixed steel security windows.
- F. Type G5 - Fire-Protection Rated Glazing - Refer to 088813 - Fire-Rated Glazing.

END OF SECTION 088000

**SECTION 088300
MIRRORS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- D. GANA (GM) - GANA Glazing Manual.
- E. GANA (SM) - GANA Sealant Manual.
- F. SCAQMD 1168 - Adhesive and Sealant Applications.

1.02 SUBMITTALS

- A. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- B. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- C. Safety Mirror Certificate: Provide certification that mirrors with film backing used for this project are tested to and pass the requirements of safety glazing per ANSI Z97.1 and CPSC 16 CFR 1201, Category II.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods, including GANA's "Glazing Manual" and "Mirrors: Handle with Extreme Care."
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.
- C. Safety Glazing: Mirrors shall be certified as safety glazing per ANSI Z97.1 and CPSC 16 CFR 1201, Category II.

1.04 FIELD CONDITIONS

- A. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for deterioration of reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Mirrors:
 - 1. Arch Aluminum and Glass Co., Inc.
-

2. Binswanger Mirror/ACI Distribution.
3. Gardner Glass Products.
4. Gilded Mirrors, Inc.
5. Guardian Industries Corp.
6. Independent Mirror Industries, Inc.
7. Lenoir Mirror Co.
8. Messer Industries, Inc.
9. Stroupe Mirror Co., Inc.
10. Sunshine Mirror.
11. Trulite Glass and Aluminum Solutions.
12. Virginia Mirror Company, Inc.
13. Walker Glass Company Ltd.

2.02 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
 1. Thickness: 1/4 inch.
 2. Size: As indicated on drawings.

2.03 ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.
- B. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
- C. Glazing Clips: Manufacturer's standard type.
- D. Fasteners/Anchors: Provide manufacturer's recommended fasteners and anchors for indicated substrates.
 1. Where metal or wood stud substrate is indicated, coordinate with Division 6 section Rough Carpentry and Division 9 section Cold-Formed Steel Framing - Non-Structural (CFSF-NS) to provide concealed blocking or reinforcing along full length of J-channel mounting locations to provide a solid substrate for fastening.
- E. Mirror Adhesive/Mastic: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 1. Low-Emitting Material: Provide mastic that is tested and determined compliant in accordance with CAL (CDPH SM) AND that meets the chemical content requirements of SCAQMD 1168.
- F. Aluminum Channel Frame: Provide J-channel framing, fabricated from minimum 0.045-inch clear anodized aluminum extrusions. Size all channel framing for 1/4 inch nominal mirror thickness, in lengths sized to cover edges of each mirror section with one continuous piece.
 1. Bottom Trim: J-channel with 3/8-inch exposure front leg, 3/4- or 7/8-inch rear leg.
Available Products:
 - a. Brunner Enterprises, Inc.; Mirror Lower "J" Channel.
 - b. C.R. Laurence Co., Inc.; CRL Standard "J" Channel.
 - c. Eagle Mouldings, Inc; Aluminum J-Cap - 3/8" Face for 1/4" Material.

2. Top Trim: J-channel with 5/8-inch exposure front leg, 1- or 1-1/8-inch rear leg. Available Products:
 - a. Brunner Enterprises, Inc.; Mirror Upper "J" Channel.
 - b. C.R. Laurence Co., Inc.; CRL Deep "J" Channel.
 - c. Eagle Mouldings, Inc; Aluminum J-Cap - 5/8" Face for 1/4" Material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Install J-channel frame sections to the wall with mechanical fasteners. Install fasteners in a manner so that they do not cause point loads to impact the rear of mirror panels.
- C. Install mirrors with mirror mastic; provide mastic in coverage amount recommended by manufacturer, and in coverage pattern allowing for air circulation behind mirrors.
- D. Set mirrors plumb and level, and free of optical distortion.
- E. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.04 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION 088300

**SECTION 088813
FIRE-RATED GLAZING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- C. GANA (GM) - GANA Glazing Manual.
- D. ITS (DIR) - Directory of Listed Products.
- E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- F. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.
- G. UL (DIR) - Online Certifications Directory.
- H. UL 9 - Standard for Fire Tests of Window Assemblies.
- I. UL 10B - Standard for Fire Tests of Door Assemblies.
- J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene preinstallation meeting one week before starting work of this section; require attendance by each of affected installers.

1.03 SUBMITTALS

- A. Product Data on Glazing Unit Glazing Types: Provide structural, physical, and environmental characteristics, size limitations, special handling and installation requirements.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Certificate: Certify that products of this section meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with GANA (GM) for glazing installation methods.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.05 FIELD CONDITIONS

- A. Ambient Conditions: 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.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty for Coated or Laminated Fire Glass: Provide five-year manufacturer warranty coverage for coating deterioration or delamination, including providing products to replace failed units, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads and withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
 - 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 - 2. Provide glass edge support system sufficiently stiff to limit lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 3. Glass thicknesses listed are minimum.

2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 - 1. Kind HS - Heat-Strengthened Type: Comply with ASTM C1048.
 - 2. Kind FT - Fully Tempered Type: Comply with ASTM C1048.

2.03 GLAZING UNITS

- A. Type G5 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire rating period(s) as indicated on drawings.
 - 1. Applications:
 - a. Glazing in fire-resistance-rated door assemblies.
 - b. Other locations as indicated on drawings.
 - 2. Glass Type: Safety ceramic glass.
 - 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 - 4. Safety Glazing Certification: 16 CFR 1201 Category II.
 - 5. Glazing Method: As required for fire rating.
 - 6. Fire-Rating Period: As indicated on drawings.
 - 7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
 - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - b. "OH" - meets fire window assembly criteria, including hose stream test of NFPA 257 or UL 9 fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
 - d. "XXX" - placeholder that represents fire-rating period, in minutes.
 - 8. Products:
 - a. SCHOTT North America Inc; PYRAN Platinum F (Surface-Applied Safety Film).
 - b. Technical Glass Products; Firelite NT.
 - c. Vetrotech North America; Keralite/Select Filmed.

2.04 ACCESSORIES

- A. Setting Blocks: Aluminum silicate, 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. Continuous by one half the height of glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Flexible tape made from spun calcium-magnesium-silica fibers in binder; designed to remain stable at temperatures up to 2,012 degrees F.
 - 1. Thickness: As recommended by framing manufacturer for glazing application.
- D. Glazing Gaskets: Flexible intumescent seals.

PART 3 EXECUTION

3.01 EXAMINATION

- 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.

3.02 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.

3.03 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 referenced glazing 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 contaminating substances that may result from construction operations including, but not limited to weld spatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from interior of building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sightline.

- C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.05 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 four days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

- A. After installation, mark pane with '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 088813

**SECTION 089100
LOUVERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.
- C. AMCA 511 - Certified Ratings Program for Air Control Devices.

1.02 SUBMITTALS

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- C. Samples: Manufacturer's color charts indicating full range of available colors.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Louvers:
 - 1. Airline Louvers.
 - 2. Airolite Company, LLC.
 - 3. American Warming and Ventilating.
 - 4. Construction Specialties, Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Industrial Louvers, Inc.
 - 7. NCA, a brand of Metal Industries Inc.
 - 8. Pottorff.
 - 9. Reliable Products, Inc.
 - 10. Ruskin.
 - 11. United Enertech.
 - 12. Substitutions: See Section 016000 - Product Requirements.

2.02 LOUVERS

- A. Louvers, General: All louvers shall be factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511; provide AMCA Certified seal/markings on all louvers.
- B. Storm-Resistant/Wind-Driven Rain Resistant Louvers: Horizontal blade, extruded aluminum construction.
 - 1. Basis-of-Design Product: Construction Specialties; RS-5300.
 - 2. Free Area: 47 percent, minimum.
 - 3. Pressure Drop: 0.10 inches of water gauge maximum per square foot of free area at velocity of 500 fpm, when tested in accordance with AMCA 500-L, test unit size 48 inch by 48 inch.
 - 4. Wind-Driven Rain Performance: AMCA certified Class A; 99 percent effectiveness when tested at a rainfall rate of 3.0 inches per hour, wind speed of 29 mph, and nominal core ventilation rate of 300 ft/min (1.5 m/s).
 - 5. Blades: Inverted V-shaped, drainable. Provide with integral gutters to direct water to the exterior.
 - 6. Frame: 5 inches deep, channel profile; corner joints mitered, with continuous recessed caulking channel each side.
 - 7. Aluminum Thickness: Frame 0.080 inch minimum; blades 0.060 inch minimum.
 - 8. Aluminum Finish: High performance organic coatings; finish welded units after fabrication.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).

2.04 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: To be selected by Architect from manufacturer's full range .

2.05 ACCESSORIES

- A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame. Provide insect screens at intake louvers and at non-ducted louvers, and provide bird screens at exhaust louvers
 - 1. Bird Screen: Interwoven wire mesh of steel, 14 gauge, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design.
 - 2. Insect Screen: 18 x 16 size aluminum mesh.
- C. Fasteners: Concealed type; stainless steel. If exposed fasteners are unavoidable, provide color-matched heads to match framing color.
- D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION 089100

SECTION 092216
COLD FORMED STEEL FRAMING - NON-STRUCTURAL (CFSF-NS)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Refer to Section 054000 - Cold-Formed Steel Framing - Structural (CFSF-S): Requirements for structural, load-bearing, metal stud framing and overhead/suspended/bulkhead framing.

1.02 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

1.03 SUBMITTALS

- A. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Steel Thickness (Studs and Runners): Minimum 0.0179-inch (18 mil / 25 gauge) unless otherwise required to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, and as indicated below:
 - a. Provide minimum 0.0329-inch thickness (33 mil / 20 gauge) for all partitions using 3-5/8-inch-deep studs where stud partition height is greater than 12 feet above floor level.
 - b. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for high-density board applications, such as ASTM C1178 tile backing panels and ASTM C1629 abuse- or impact-resistant gypsum board, and at door frames.
 - c. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for walls receiving heavy wall-hung items or loads, including but not limited to wall cabinets, wall-hung countertops, TV brackets, liquid tanks, folding and fixed seats, grab bars, handrails, exercise equipment, and shelving greater than 9 inches deep and over 3 feet in length.
 - 2. Studs: C-shaped with flat faces.
 - 3. Runners: U-shaped, sized to match studs.

4. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - a. Minimum Steel Thickness: Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for all shaft wall stud applications.
 - b. Studs: C-T shaped shaft wall stud profile.
 - c. Runners and Jamb Struts: J-shaped with tabs, sized to match studs.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
6. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
- B. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- C. Non-Loadbearing Framing Accessories:
 1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 2. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; cold-rolled channel / hat-section profile; for lateral bracing of wall studs with slots for engaging on-module studs.
 3. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
 4. Sheet Metal Backing: 0.036 inch thick flat strap/plate.
 5. Fasteners: Self-tapping screws designed for attachment of metal framing and recommended by manufacturer.
 6. Anchorage Devices: Powder actuated or screw anchors with sleeves, recommended by manufacturer for anchorage to indicated substrates.
 7. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced. Thickness as indicated, or sized to fit stud depth indicated.
 8. Acoustic Sealant: Refer to Division 07 Section "Joint Sealants."

2.02 GYPSUM BOARD SUSPENSION SYSTEM

- A. For interior overhead gypsum board, in lieu of separate stick built fixed-framing bulkheads and soffits fabricated of Structural Cold-Formed Steel Framing (CFSF-S), Contractor may provide a direct hung suspension system, per ASTM C645, composed of pre-fabricated beams and cross-furring members, specifically designed for use with gypsum board.
- B. Products:
 1. Armstrong; Quikstix Drywall Grid System.
 2. Certainteed; 1-1/2" Drywall Suspension System.
 3. Rockfon; Chicago Metallic Drywall Grid System.
 4. USG; Drywall Suspension System.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Install in accordance with ASTM C754. Provide framing, including bracing, bridging, and anchorage accessories, to meet L/240 deflection limit at a lateral pressure of 5 psf unless indicated otherwise.
 - 1. Gypsum Board: At gypsum board partitions and assemblies, comply with applicable requirements of ASTM C840 for framing installation.
- B. Extend partition framing to deck at locations indicated, and to a height 4 inches above ceiling level at all other locations, unless otherwise indicated.
- C. Partitions Terminating to Deck: Secure partitions to building structure in accordance with Structural Drawings. Do not fasten runner directly to floor/roof deck; provide clearance for firestopping. Coordinate with Section 078400 - Firestopping for head-of-wall joint firestopping assemblies and firestopping around structural elements as required.
- D. Partitions Terminating Above Ceiling: Attach studs to runner using specified mechanical devices in accordance with manufacturer's instructions. Brace runners to structural elements in accordance with Structural Drawings.
- E. Align and secure top and bottom runners at maximum 24 inches on center.
- F. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at 16 inches on center, unless otherwise indicated.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.
- K. Fabricate corners using a minimum of three studs.
- L. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- M. Install bracing, bridging, and anchorage to brace stud framing system rigid.
- N. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- O. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- P. Blocking: Use FRT wood blocking or metal channel stud blocking, secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and other built-in-place wall mounted items and equipment.
- Q. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.03 GYPSUM BOARD SUSPENSION SYSTEM

- A. Install suspension system in accordance with manufacturer's instructions. Do not attach overhead suspension hangers to or suspend from steel floor or roof deck; fasten to primary structural beams/joists or provide intermediate slotted track as supplemental structure between primary structural elements.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 092216

**SECTION 092900
GYPSUM BOARD**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- I. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- J. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- K. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- N. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.
- O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- P. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- Q. GA-216 - Application and Finishing of Gypsum Panel Products.
- R. UL 752 - Standard for Bullet-Resisting Equipment.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- B. Ballistic Test Reports: Indicate compliance of bullet-resistant sheathing and wallboard assemblies with specified requirements.

1.03 DELIVERY, STORAGE, HANDLING, AND FIELD CONDITIONS

- A. Do not deliver or install until building is weather-tight and conditioned.

- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.
- C. Do not install gypsum products that have gotten wet or moldy, or show signs of past moisture damage.
- D. Maintain uniform temperature and humidity at occupancy conditions during and after installation. Allow products to acclimatize prior to installation.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; with tapered edges.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever gypsum board is indicated in rooms subject to steam or water, including mechanical rooms, toilet rooms, custodial rooms, and kitchens.
 - 3. 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.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Curved Surfaces: Provide flexible 1/4 inch thickness gypsum board, installed in two layers.
- B. Impact Resistant Wallboard:
 - 1. Application: High-traffic areas indicated.
 - 2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 7. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
 - 8. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
 - 9. Type: Fire-resistance-rated Type X, UL or WH listed.
 - 10. Thickness: 5/8 inch.
 - 11. Edges: Tapered.
 - 12. Paper-Faced Products:
 - a. American Gypsum Company; M-Bloc IR Type X.
 - b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech.
 - c. National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 13. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.

- b. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough VHI.
 - c. Substitutions: See Section 016000 - Product Requirements.
- C. Tile Backing Board:
- 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. ANSI Cement-Based Board: Non-gypsum-based; cementitious panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 and ASTM C 1288 or ASTM C1325.
 - a. Thickness: 5/8 inch.
 - b. Available Products:
 - 1) FinPan, Inc.; Util-A-Crete Backer Board.
 - 2) National Gypsum Company; PermaBase Cement Board.
 - 3) USG Corporation; Durock Cement Board.
 - 4) Substitutions: See Section 016000 - Product Requirements.
- D. Bullet Resistant Sheathing and Wallboard: Woven roving, multi-ply, ballistic grade fiberglass cloth with thermoset polyester resin; comply with UL 752 Level 3. Size boards to minimize joints.
- 1. Thickness: Nominal 7/16 inch or 1/2 inch as standard with manufacturer.
 - 2. Available Products:
 - a. ArmorCore by Waco Composites; Bullet Resistant Fiberglass Panels.
 - b. Armortex, Div. of Safeguard Security System, Inc.; OF 300.
 - c. Chicago Bullet Proof Systems; Fibre-Tex.
 - d. C.R. Laurence of North America; BRF300.
 - e. Insulgard Corporation; FG-300.
- E. Exterior Sheathing Board for Ceilings and Soffits: Sizes to minimize joints in place; ends square cut.
- 1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 2. Fungal Resistance: No fungal growth when tested in accordance with ASTM G21.
 - 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 - 4. Edges: Square.
 - 5. Available Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Exterior Sheathing.
 - b. CertainTeed Corporation; GlasRoc Exterior Sheathing.
 - c. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - d. National Gypsum Company; Gold Bond eXP Sheathing.
 - e. USG Corporation; USG Securock Brand Ultralight Glass-Mat Sheathing.
- F. Shaftwall Liner Panels: Type X; 1 inch thick, square long edges, ends square cut.
- 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

2.02 GYPSUM BOARD ACCESSORIES

- A. Sound Attenuation Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness sized to fit metal stud cavity.

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- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant. Refer to sealant AS-1 in Division 07 Section "Joint Sealants."
- C. Putty Pads: Non-hardening endothermic material, in pad form, faced on both sides with poly liner, designed to seal around penetrations and wiring devices, enhancing acoustic performance.
 - 1. Nominal Size: 7-1/4 x 7-1/4 x 3/16 inches.
 - 2. Available Products:
 - a. 3M; Fire Barrier Moldable Putty Pads MPP+.
 - b. Hilti; Firestop Putty Pad, CFS-P PA.
 - c. Specified Technologies, Inc.; SpecSeal Putty Pad.
- D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Corner Beads: Low profile, for 90 degree outside corners.
 - 2. L-Bead, LC-Bead, and U-Bead: Sized to fit gypsum wallboard size(s) indicated.
 - a. Provide LC-bead at exposed panel edges and U-bead at concealed panel edges, unless otherwise indicated. Provide L-bead at locations indicated.
- E. Decorative Metal Trim:
 - 1. Material: Extruded aluminum alloy 6063-T5 temper.
 - 2. Finish: Anodized, clear.
 - 3. Type: Profile(s) as indicated on Drawings; selected from manufacturer's standard range.
 - 4. Reveal Trim: Provide 1/2-inch wide by either 1/2-inch or 5/8-inch deep, as standard with manufacturer.
 - a. Products:
 - 1) Fry Reglet; Model DRM-625-50.
 - 2) Flannery, Inc; Model DWR 625-50.
 - 3) Gordon, Inc; Part # 512-5/8.
 - 4) Pittcon Industries; Model SWR-050-063.
 - 5) Tamlyn; Model RV5-12.
 - 5. "F" Reveal Molding: 1/2-inch wide by 5/8-inch deep with 7/8-inch flange on one side only for reveals where drywall terminates against jamb, ceiling, or other finish material.
 - a. Products:
 - 1) Fry Reglet; Model DRMF-625-50.
 - 2) Flannery, Inc; Model DWRF 625-50.
 - 3) Gordon, Inc; Part # 412-5/8.
 - 4) Pittcon Industries; Model SWR-050U-063.
 - 5) Tamlyn; Model MCR5-12
 - 6. L-Trim Molding: "L" angle molding where drywall raised panel terminates at other substrates.
 - a. Products:
 - 1) Fry Reglet: Model DRML-625.
 - 2) Flannery, Inc; Model DWL 625.
 - 3) Gordon, Inc; Part # 258.
 - 4) Pittcon Industries; Model ST-063.
 - 5) Tamlyn; Model MLR-58.
 - 7. Stepped Outside Corner: Exposed metal reveal profile for 90 degree outside corners.

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- a. Products:
 - 1) Fry Reglet; Model DRMW 625-625.
 - 2) Flannery, Inc; Model DWRW 625-625.
 - 3) Gordon, Inc; Part # 945-2X-58.
 - 4) Pittcon Industries; Model SCS-2X 063-063.
 - 5) Tamlyn; (no product - provide custom to match profiles above).
 - F. Metal Edge Trim for "Cloud" Suspended Ceilings: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for a complete trim system.
 - 1. Trim Height: 4 inches.
 - 2. Finish: Baked enamel; white.
 - 3. Available Products:
 - a. Armstrong World Industries, Inc.; Axiom Classic.
 - b. Certainteed; Terminus Perimeter Trim.
 - c. Chicago Metallic Corp.; Infinity System.
 - d. USG Corporation; Compasso Suspension Trim.
 - G. Acoustic Partition Closure at Storefront or Curtain Wall: Multi-piece rectangular-section assembly of nested U-shape aluminum extrusions for finished closure between aluminum storefront or curtainwall system vertical mullion (and glass where indicated), and partition assembly. Closure shall allow for movements of framing and glass it attaches to, and shall not allow direct metal to glass contact. Fill cavity of partition closure with acoustic batt insulation.
 - 1. Thickness: Aluminum closure plates not less than 0.125-inch thick.
 - 2. Acoustic Rating: Provide product with a minimum tested STC rating of 55.
 - a. Acoustic Material: Fungi- and microbe-resistant foam, Class A rated when tested per ASTM E 84.
 - 3. Acoustical Sealant: Seal both ends of partition closure with acoustical sealant.
 - 4. Finish: Powder coat; color selected by Architect from manufacturer's full range.
 - 5. Available Products:
 - a. Gordon, Inc; Mullion Mate.
 - b. Mull-It-Over Products; Mull-It-Over.
 - H. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - I. Exterior Soffit Vents: One piece, perforated, ASTM B221 6063 T5 alloy aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.
 - 1. Available Manufacturers:
 - a. Fry Reglet.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - d. Stockton Products.
 - 2. Flat, horizontal-to-horizontal application: 2-inch wide with three rows of vent slots for a minimum of 3 square inches of opening per linear foot.
 - 3. Finish: High performance organic coating; color selected by Architect from manufacturer's full range.
 - J. Security Barrier Mesh: ASTM F 1267, Type II, Class 1; expanded and flattened diamond mesh security barrier. Fabricate of uncoated, minimum 18 gage carbon steel, weight 0.66 lbs/sq. ft. Provide with lath mesh size approximately 1/2-inch by 1-1/4-inch.
-

1. Mesh Fasteners: Provide fasteners that are non-corrosive to both mesh and framing substrate; as recommended by manufacturer for mesh-to-mesh and mesh-to-framing fastening.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Sound Attenuation Batts: 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.

3.04 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.
- 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. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Security Gypsum Partitions and Ceilings: At security gypsum assemblies indicated, install expanded/flattened metal security barrier mesh followed by impact resistant gypsum board.
- F. Install gypsum board with an open horizontal joint (gap) not to exceed 5/8-inch above finished floor slab, and tape and finish vertical joints to bottom edge of board to afford a smooth substrate for applied wall base.
- G. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- H. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- I. Bullet Resistant Sheathing and Wallboard:
 1. Install bullet-resistant sheathing according to manufacturer's written recommendations and with manufacturer-approved fasteners.
 2. Cover all joints between boards with a 4-inch strip of the same thickness material as the boards, centered on the joint.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints in compliance with ASTM C 840, consistent with lines of building spaces, and as indicated.
-

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. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.
- D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on drawings. Provide vent area specified.
- E. Putty Pads: Install putty pads on the backside of items penetrating gypsum board on STC-rated walls/partitions. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

3.06 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. 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.
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092900

**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. 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.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, of each type.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Provide each acoustical ceiling assembly (ceiling panel and suspension system) from a single manufacturer to obtain manufacturer's system warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver until building is weather-tight and conditioned.
- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

1.05 FIELD CONDITIONS

- A. Maintain uniform temperature and humidity at occupancy conditions during and after acoustical unit installation. Allow products to acclimatize prior to installation.

1.06 WARRANTY

- A. System Warranty: Provide a single source system warranty covering both acoustical ceiling panels and suspension system.
 - 1. Warranty shall cover material failures including sag, warping, shrinkage, or delamination, biologic growth including mold or mildew, and rusting of suspension system.
 - 2. Warranty Period: Minimum 15 years, from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Each acoustical ceiling shall be Class A rated, with flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7, which references applicable requirements of ASTM E580/E580M "Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Subject to Earthquake Ground Motions." for Seismic Design Category indicated on Structural Drawings and complying with local authorities having jurisdiction.

2.02 ACOUSTICAL PANELS

- A. Acoustical Panels - General: ASTM E1264, Class A.
 - 1. Antibacterial/Antimicrobial Treatment: Provide acoustical panels that have been factory-treated by manufacturer for resistance to bacteria, mold, mildew, and fungus.
 - 2. Humidity/Sag Treatment: Provide acoustical panels that have been factory-treated by manufacturer for humidity and sag-resistance.
- B. Acoustical Panels, Type ACP-A: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: Not less than 0.88, determined in accordance with ASTM E1264.
 - 5. NRC Range: Not less than 0.75, determined in accordance with ASTM E1264.
 - 6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Square.
 - 8. Color: White.
 - 9. Products:
 - a. Armstrong World Industries, Inc; Ultima - Item #1910.
 - b. CertainTeed Ceilings, Inc.; Symphony m - Item #1222-75-1.
 - c. USG Corporation; Mars Acoustical Panels - Item #86185.
 - d. Substitutions: See Section 016000 - Product Requirements.
- C. Acoustical Panels ACP-B: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 - 2. Size: 24 by 24 inches.
 - 3. Thickness: 3/4 inch.
 - 4. Light Reflectance: Not less than 0.86, determined in accordance with ASTM E1264.
 - 5. NRC Range: Not less than 0.70, determined in accordance with ASTM E1264.

6. Ceiling Attenuation Class (CAC): Not less than 35, determined in accordance with ASTM E1264.
7. Panel Edge: Square.
8. Color: White.
9. Products:
 - a. Armstrong World Industries, Inc; Ultima Health Zone - Item #1935.
 - b. CertainTeed Ceilings, Inc.; Performa Rx Symphony m - Item #1222-RSX-1.
 - c. USG Corporation; Mars Healthcare - Item #86169.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
 2. Cross Tee/Main Runner Connection: Override (stepped).
 3. Main Runner End Coupling: Bayonet ("stab") type; knuckle type is not acceptable.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap.
 1. Application(s): Seismic.
 2. High Humidity Applications: Provide in kitchens, rooms with showers, custodial rooms, mechanical rooms, and other rooms where increased corrosion resistance due to humidity or steam is required.
 3. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 4. Coating: Provide minimum G60 hot-dip galvanized coating.
 5. Profile: Tee; 15/16 inch face width.
 6. Finish: Baked enamel.
 7. Color: White.
 8. Products:
 - a. Armstrong World Industries, Inc; Prelude Plus XL Fire Guard.
 - b. CertainTeed Ceilings, Inc; 15/16" EZ Stab Classic Environmental System.
 - c. USG Corporation; Donn Brand ZXLA 15/16 inch Acoustical Suspension System.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- E. Perimeter Moldings: Same metal and finish as grid.
 1. Size: As required for installation conditions and specified Seismic Design Category.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- D. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch clearance between grid ends and wall.
- E. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- F. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
-

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B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 095100

**SECTION 096513
RESILIENT BASE AND ACCESSORIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base.
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- F. ASTM F2169 - Standard Specification for Resilient Stair Treads.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Provide resilient base, molding, transitions, and edge strips from a single manufacturer.

1.04 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. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- C. Protect roll materials from damage by storing on end.

1.05 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.
- B. Maintain conditions at occupancy conditions for installation and until Substantial Completion.

PART 2 PRODUCTS

2.01 RESILIENT BASE

- A. Resilient Base - Type RB: ASTM F1861, Type TP, rubber, thermoplastic; Style B, Cove.
 - 1. Products (Type TP):

- a. Flexco (USA), Inc.; Flexco Base 2000 - Cove.
 - b. Johnsonite, a Tarkett Company; Rubber Wall Base - Cove.
 - c. Mannington Commercial; Burkebase Type TP - Coved.
 - d. Roppe Corporation; 700 Series TPR Wall Base - Style B (Coved).
 - e. Substitutions: See Section 016000 - Product Requirements.
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 3. Height: 4 inch.
 4. Thickness: 0.125 inch minimum.
 5. Finish: Satin.
 6. Length: Roll; manufacturer's standard length.
 7. Color: To be selected by Architect from manufacturer's full range.

2.02 MOLDINGS, TRANSITIONS, AND EDGE STRIPS

- A. Moldings, Transition and Edge Strips:
 1. Manufacturers:
 - a. Flexco, Inc.
 - b. Johnsonite.
 - c. Mannington Commercial.
 - d. Roppe Corporation.
 - e. Substitutions: See Section 016000 - Product Requirements.
 2. Molding/Transition Strip Profiles: Provide in sizes as required to suit flooring thicknesses and applications.
 - a. Coved edge/cap for carpet.
 - b. Joiner between carpet and resilient flooring or other materials with different heights.
 - c. Transition strip between different types of materials that are the same height or between different styles/patterns of the same material.
 3. Material: Manufacturer's standard rubber or vinyl.
 4. Color: To be selected by Architect from manufacturer's full range.

2.03 ACCESSORIES

- A. Leveling Compound: Blended cement mix, latex-modified, for use as trowelable underlayment, approved by resilient accessory manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.

- b. Low-VOC: Provide product with VOC content less than 15 g/L.
- c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
- d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
- e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 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.
 - 1. Do not apply wall base until other finish items, including casework and painting, are complete.
- C. Cementitious Subfloor Surfaces (Stair Treads/Landings): Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710, when required by stair accessory manufacturer.
 - b. Internal Relative Humidity: ASTM F2170. One test per stair area.
 - c. Moisture Vapor Emission: ASTM F1869. One test per stair area.
 - 2. If test results are not within limits recommended by stair accessory manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.

3.02 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 leveling compound to achieve smooth, flat, hard surface.
- C. Prohibit traffic until leveling compound is fully cured.
- D. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, install such that molding profiles or transition strips are centered under the door panel.
- E. Install edge/reducer strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Job form internal and external corners in accordance with manufacturer's instructions. Form corners by "V" cutting or scribing; do not bend material in a manner that creates stress whitening.
- D. In addition to walls, install base on other permanent construction with exposed vertical faces at floor level, including, but not limited to, columns, pilasters, and casework/cabinet knee and toe spaces.
- E. Scribe and fit to door frames and other interruptions.
- F. At uneven substrate surfaces (such as masonry mortar joints), provide manufacturer's recommended filler sealant or adhesive to fill voids along top of base.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient accessories for 48 hours after installation.
- B. Cover resilient accessories and protect from heavy construction traffic and equipment until Substantial Completion.

END OF SECTION 096513

**SECTION 096516
RESILIENT SHEET FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Shop Drawings: Indicate seaming plans, floor patterns, and dye lot.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.04 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.

1.05 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.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.

- C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.
 - 1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring - SV-B: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Manufacturers:
 - a. Patcraft; Holistic Collection. (basis of design)
 - b. Mannington Commercial.
 - c. Milliken.
 - d. Shaw Contract.
 - e. Tarkett.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. Thickness: 0.080 inch nominal (2mm).
 - 4. Sheet Width: 49 inch minimum.
 - 5. Static Load Resistance: 2000 psi minimum, when tested as specified in ASTM F970.
 - 6. Seams: Heat welded.
 - 7. Integral covered base with cap strip.
 - 8. Color: To be selected by Architect from manufacturer's full range.
- B. Vinyl Sheet Flooring - SV-A: Color and pattern throughout wear layer thickness, with backing.
 - 1. Manufacturers:
 - a. Altro Floors; Atlas 40.
 - b. Oscoda Plastics, Inc; Protect-All Specialty Flooring.
 - c. Polyflor Ltd; Polysafe Apex.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1303, Type II, except for wear-layer binder content and backing requirements. Provide un-backed floor covering.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 4. Total Thickness: 0.25 inch.
 - 5. Sheet Width: As standard with manufacturer.
 - 6. Seams: Heat welded.
 - 7. Integral covered base with cap strip.
 - 8. Color: To be selected by Architect from manufacturer's full range.
- C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 ACCESSORIES

- A. Subfloor Filler: Type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

- C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, and where field testing indicates high moisture vapor testing through concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab in accordance with Division 01 MVT allowance and unit price, and per the following:
1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.
- D. Floor Drain Rings: Stainless steel drain accessories, recommended by sheet vinyl flooring manufacturer, fabricated for use with flanged floor drain specified in Division 22 for permanent, non-leaking floor drain installation in sheet flooring at wet or kitchen areas indicated.
1. Manufacturers:
 - a. Campbell Grinding & Machine; Lewisville, TX.
 - b. MO Manufacturing; El Dorado Springs, MO.
 - c. Stainless Steel Fabricators; Raleigh, NC.
 - d. Stainless Steel Works, Inc; Salt Lake City, UT.

PART 3 EXECUTION

3.01 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. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 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.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.
- C. Seal seams by heat welding.
- D. Coved Base: Install according to manufacturer's instructions, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096516

**SECTION 096519
RESILIENT TILE FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.02 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Shop Drawings: Indicate seaming plans, floor patterns, and dye lot.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 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.

1.04 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.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.
- C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.
 - 1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Enhanced Vinyl Composition Tile (Quartz Tile) - QCT: Solid, homogenous tile with 70% natural quartz content and 15% vinyl.
-

1. Manufacturers:
 - a. Kahrs Flooring; Upofloor Quartz. (basis of design)
 - b. Altro Group; Altro Quartz Tile.
 - c. Procedo Flooring; Versa Quartz.
2. Minimum Requirements: Comply with ASTM F1700, Class I (Monolithic Vinyl Tile) or ASTM F1066, Class 2 (Through-Pattern).
 - a. Type: Type A, Smooth Surface.
3. Size: 12 x 12 inch, 12 x 24 inch, or 24 x 24 inch square tiles.
4. Thickness: 0.080 inch (2 mm), 0.100 inch (2.5 mm), or 0.120 inch (3 mm), as standard with manufacturer.
5. Color and Pattern: To be selected by Architect from manufacturer's full range.

2.02 ACCESSORIES

- A. Subfloor Filler: Type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, and where field testing indicates high moisture vapor testing through concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab in accordance with Division 01 MVT allowance and unit price, and per the following:
 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 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. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
 - a. Alkalinity (pH): ASTM F710.

- b. Internal Relative Humidity: ASTM F2170.
- c. Moisture Vapor Emission: ASTM F1869.
- 2. If test results are not within limits recommended by flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.

3.02 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.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Fit joints and butt seams tightly.
 - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 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, unless otherwise indicated.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096519

**SECTION 096566
RESILIENT ATHLETIC FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's printed data sheets for products specified.
- B. Shop Drawings: Fabrication and installation details. Include layout, color(s), dye lot, and orientation.
 - 1. Indicate columns, electrical outlets, athletic equipment inserts, and other floor penetrations or items installed through resilient athletic flooring.
- C. Selection Samples: Manufacturer's color charts for flooring materials specified, indicating full range of colors and textures available.
- D. Installer's qualification statement.
- E. Maintenance Data: For resilient athletic flooring.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and certified/approved by flooring manufacturer for installation of specified flooring system.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.
- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.05 FIELD CONDITIONS

- A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F or to go above 100 degrees F.

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

- A. Rubber Tile Flooring - RAF: Recycled rubber and colored EPDM granules with urethane binder.
 - 1. Backing: Recycled black rubber, laminated to colored top layer.
 - 2. Thickness: Nominal 3/8 inch (9.5 - 10 mm).
 - 3. Size: Manufacturer's standard square tile.
-

4. Tensile Strength: Minimum 150 psi, per ASTM D412.
5. Tile Edge/Installation: Straight, adhesive installation.
6. Surface Texture: Smooth.
7. Color: To be selected by Architect from manufacturer's full range.
8. Products:
 - a. Amarco; Sport-Fleck.
 - b. American Floor Products Company (AFCO); Coronado 90 (FE-1015).
 - c. Connor Sports; Elastimat.
 - d. Dynamic Sports Construction, Inc.; DynaFit.
 - e. Horner Sports Flooring; EcoTuff.
 - f. Mats Inc.; Duo Tile.
 - g. Mondo; Ramflex.
 - h. Tarkett; Replay.

2.02 ACCESSORIES

- A. Leveling Compound: Latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.
- B. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.
- C. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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 athletic flooring to substrate.

- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710, when required by flooring manufacturer.
 - b. Internal Relative Humidity: ASTM F2170. One test per installation area.
 - c. Moisture Vapor Emission: ASTM F1869. One test per installation area.
 - 2. After testing is complete, prepare concrete and install moisture vapor treatment (MVT) in accordance with manufacturer's written instructions. If testing indicates measurements are within acceptable levels for flooring installation with the need for MVT, the MVT may be omitted where approved by the Architect.
 - 3. After installation of MVT, perform final moisture tests to verify that moisture-vapor-emission-rate is at an acceptable level for stair accessory installation. Proceed with installation only after moisture-vapor-emission-rate and relative humidity do not exceed the following:
 - a. Moisture-Vapor-Emission Rate: Maximum 3lbs. of water/1,000 sq. ft. in 24 hours, unless indicated otherwise by resilient accessory manufacturer.
 - b. Relative Humidity: Maximum 75 percent relative humidity, unless indicated otherwise by resilient accessory manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.
- C. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.
- D. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Rubber Tile Flooring:
 - 1. Lay out center lines in spaces to receive tile flooring, based on location of principal walls. Start tile installation from center, and adjust as necessary to avoid tiles less than one-half width at perimeter.
 - 2. Lay tiles square with room axis, unless otherwise indicated, matching for color and pattern by selecting from cartons and mixing as recommended by manufacturer.
 - 3. Spread only enough adhesive to permit installation of materials before initial set.
 - 4. Fit joints and butt seams tightly; press with heavy roller to attain full adhesion.
- D. Extend flooring into accessory spaces (such as closets, wall recesses, or toe spaces) and to center line of cased openings or center line of door leaf at door openings, unless otherwise indicated. Where transitions occur between resilient athletic flooring and other flooring types, extend or cut flooring to suit transition.

3.04 CLEANING

- A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

- A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION 096566

**SECTION 096700
FLUID-APPLIED FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- E. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
 - 1. Require attendance by representatives of installer and other entities directly affecting, or affected by, construction activities of this section.
 - 2. Notify Architect four calendar days in advance of scheduled meeting date.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- B. Selection Samples: Provide manufacturer's color charts illustrating full range of patterns and colors for each flooring material.
- C. Verification Samples: Manufacturer's standard size physical samples, on rigid backing, illustrating each selected pattern and color.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- F. Applicator's Qualification Statement.
- G. Field Quality Control Reports: Submit inspection reports of manufacturer's technical representative.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section; certified and approved by manufacturer in writing.
 - 1. Approved by manufacturer.

1.05 MOCK-UPS

- A. Construct mock-up(s) of each type of fluid applied flooring and wall coating to serve as basis for evaluation of texture and workmanship.

1. Number of Mock-Ups to be Prepared: One.
 2. Use same materials and methods for use in the work.
 3. Use approved design samples as basis for mock-ups.
 4. Locate where directed by Architect.
 5. Minimum Size: 48 inches by 48 inches.
- B. See Section 014000 - Quality Requirements for additional requirements.
- C. Obtain approval of mock-up by Architect before proceeding with work.
- D. Approved mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fluid-Applied Flooring:
1. Crossfield Products Corp.
 2. Dur-A-Flex, Inc.
 3. Elite Crete Systems.
 4. Key Resin Company.
 5. Master Builders Solutions.
 6. Sherwin-Williams Company.
 7. Sika Corporation.
 8. Stonhard, Inc.
 9. Substitutions: See Section 016000 - Product Requirements.
- B. Source Quality Control: Complete fluid-applied flooring system shall be supplied by a single manufacturer.
1. Accessory and floor preparation products shall be provided by fluid-applied manufacturer or by a manufacturer approved for compatibility by the primary fluid-applied manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Specific requirements for each system are indicated in the article below. Where a specific Basis-of-Design value is indicated, minor variations in test numbers shall be permitted for comparable/substitute products at Architect's discretion.
- B. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648.
- C. Slip Resistance: Minimum dynamic coefficient of friction (DCOF) of 0.6, when tested in accordance with NFSI / ANSI B101 Standard.

2.03 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring (RES-A1): Hybrid system consisting of urethane base coat, epoxy bonding coat, quartz broadcast aggregate, and aliphatic polyaspartic polyurethane top coat.
 - 1. Basis-of-Design System: Stonhard; Stonetec TRF.
 - 2. Compressive Strength: 5,000 psi, minimum, when tested in accordance with ASTM C579.
 - 3. Abrasion Resistance: Maximum weight loss of 70-90 mg, when tested in accordance with ASTM D4060 (Basis-of-Design).
 - 4. Impact Resistance: No cracking, chipping or delamination, when tested with Gardner Impact Tester at 16 ft lbs.
 - 5. Adhesion: Minimum 300 psi at concrete substrate failure, per ASTM D4541.
 - 6. System Thickness: 1/4 inch, nominal, dry film thickness (DFT).
 - 7. Aggregate: Quartz granules.
 - 8. Texture: Slip resistant.
 - 9. Sheen: Semi-gloss.
 - 10. Color: To be selected by Architect from manufacturer's full range.
 - 11. Provide cove base matching floor system, as indicated on Drawings.

2.04 FLUID APPLIED WALL SYSTEMS

- A. Urethane Coating (RES-B):
 - 1. Basis-of-Design System: Stonhard, Inc; Stoneglaze VSE.
 - 2. Number of Coats: Two.
 - 3. Product Characteristics:
 - a. Dry film thickness, per coat: 6-7 mils, minimum. Total DFT 12-15 mil.
 - 4. Top Coat(s): Polyurethane, Two-Component.
 - a. Sheen: Eggshell.

2.05 ACCESSORIES

- A. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- B. Primer: Type recommended by fluid-applied flooring manufacturer.
- C. Moisture Vapor Treatment: Where fluid-applied flooring and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
 - 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 - 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.
 - c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.

- e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
 - 1. Test as Follows: Perform one test in each installation area.
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 2. If test results are not within limits recommended by fluid-applied flooring manufacturer, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements. MVT shall be provided per unit price and quantity allowance requirements.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Prepare concrete surfaces according to ICRI 310.2R, CSP 4, minimum, unless otherwise required by manufacturer's installation requirements..
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.
- E. Apply primer to surfaces required by flooring manufacturer.

3.03 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness required by manufacturer.
- C. Finish to smooth level surface.
- D. Install flooring to the center of cased openings, and into door openings such that the transition to other floor material will occur under the center of the door leaf. Where transitions occur to another flooring material, extend resinous flooring to suit transition.
- E. Cove at vertical surfaces.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of manufacturer's technical representative to inspect for proper installation of fluid-applied flooring system and submit inspection report.

3.05 PROTECTION

- A. Prohibit traffic on floor finish for minimum 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

END OF SECTION 096700

**SECTION 096813
TILE CARPETING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Substitutions/Prequalification: Manufacturers seeking consideration to bid their product as an acceptable alternative shall provide full product data and full range of selection samples during the bid period. Products that do not meet the technical and aesthetic criteria will not be accepted. No substitutions shall be permitted for carpet tile after receipt of bids.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Shop Drawings: Indicate layout of joints, direction of carpet pile, dye lot, and location of edge moldings and transition strips.
 - 1. Where multiple carpet tile products are specified (including multiple products in a single space installed in an indicated pattern), indicate on the shop drawings the locations where each product is being installed.
- C. Selection Samples: Submit manufacturer's binder indicating full range of colors for carpet tiles and for accessories.
- D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
 - 1. Include specific procedures and materials that are not recommended, including those that may be harmful to carpet tile or that would void warranty.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

- A. Critical Radiant Flux: All carpet tiles shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with ASTM E648 or NFPA 253.

1.05 FIELD CONDITIONS, STORAGE AND HANDLING

- A. Comply with the Carpet and Rug Institute (CRI) Publication "CRI 104 - Standard for Installation of Commercial Carpet." Comply with Section 4.0 for storage and handling, Section 7.0 for ambient temperature and ventilation, and Section 9.0 for Product Acclimation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Carpet Tile Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and faulty installation.

1. Warranty shall cover excessive surface wear (defined as more than 10% loss by weight of face fiber), edge raveling, backing separation, shrinking, stretching, cupping, doming, static electricity, or color loss or fading.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting: Provide the basis-of-design carpet tiles or a prequalified alternate tile. No substitutions will be considered after the award of Contract.
 1. Bentley Mills; Redux Deux. (basis of design)
 2. Interface, Inc.
 3. Mannington Commercial.
 4. Milliken & Company.

2.02 MATERIALS

- A. Tile Carpeting, Type C-TILE-A: Tufted textured loop, manufactured in one color dye lot.
 1. Product: Redux Deux manufactured by Bentley Mills..
 2. Tile Size: 24 by 24 inch, nominal.
 3. Color: As selected by Architect from manufacturer's full range..
 4. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 5. Primary Backing Material: AFIRMA II Hardback Tile.
- B. Tile Carpeting, Type C-TILE-B: Tufted tip-sheared, manufactured in one color dye lot.
 1. Product: Rough Idea manufactured by Bentley Mills..
 2. Tile Size: 24 by 24 inch, nominal.
 3. Color: As selected by Architect from manufacturer's full range..
 4. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 5. Primary Backing Material: AFIRMA II Hardback Tile.
 - 6.

2.03 ACCESSORIES

- A. Subfloor Filler: Type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Moisture Vapor Treatment: Where carpeting and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
 1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
 - a. Duraamen Engineered Products, Inc.; Perdure MVT.
 - b. Maxxon Corporation; Maxxon MVP.
 - c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
 2. Performance Requirements:
 - a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer's warranty.
 - b. Low-VOC: Provide product with VOC content less than 15 g/L.

- c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
 - d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft²/in-Hg, per ASTM F3010.
 - e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in _____ pattern selected by Architect, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated.
- F. Locate change of color or pattern between rooms or at transitions to other finish flooring material directly under the door leaf centerlines, or at the center of cased openings.
- G. Fully adhere carpet tile to substrate.
- H. Install carpet tile into wall recesses, knee spaces under cabinets or countertops, closets, and other similar spaces.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING AND PROTECTION

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

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C. Protect installed carpet in accordance with CRI 104, Section 13.7 "Post Installation."

END OF SECTION 096813

SECTION 096813.13
STATIC-CONTROL TILE CARPETING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets.
- B. ANSI/ESD STM7.1 - The Protection of Electrostatic Discharge Susceptible Items Flooring Systems Resistive Characterization.
- C. ANSI/ESD STM97.1 - ESD Association Standard Test Method for the Protection of Electrostatic Discharge Items - Floor Materials And Footwear - Resistance Measurement in Combination with a Person.
- D. ANSI/ESD STM97.2 - Floor Materials and Footwear - Voltage Measurement in Combination with a Person.
- E. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- F. CRI 104 - Standard for Installation of Commercial Carpet.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Substitutions/Prequalification: Manufacturers seeking consideration to bid their product as an acceptable alternative shall provide full product data, test data indicating static-dissipative properties, and full range of selection samples during the bid period. Products that do not meet the technical and aesthetic criteria will not be accepted. No substitutions shall be permitted for carpet tile after receipt of bids.
- B. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Shop Drawings: Indicate layout of joints, direction of carpet pile, dye lot, and location of edge moldings and transition strips.
 - 1. Where multiple carpet tile products are specified (including multiple products in a single space installed in an indicated pattern), indicate on the shop drawings the locations where each product is being installed.
 - 2. Include grounding layout.
- C. Selection Samples: Submit manufacturer's color charts indicating full range of colors for carpet tiles and for accessories.
- D. Verification Sample: Submit full size sample for each required color, pattern, and texture.
 - 1. Submit samples in manufacturer's standard size for each accessory product.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1. Include specific procedures and materials that are not recommended, including those that may be harmful to carpet tile or that would void warranty.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing static-control flooring.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.05 FIELD CONDITIONS, STORAGE AND HANDLING

- A. Comply with the Carpet and Rug Institute (CRI) Publication "CRI 104 - Standard for Installation of Commercial Carpet." Comply with Section 4.0 for storage and handling, Section 7.0 for ambient temperature and ventilation, and Section 9.0 for Product Acclimation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Carpet Tile Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and faulty installation.
 1. Warranty shall cover excessive surface wear (defined as more than 10% loss by weight of face fiber), edge raveling, backing separation, shrinking, stretching, cupping, doming, static electricity, or color loss or fading.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Electrostatic-Dissipative (ESD) Tile Carpeting: Provide the basis-of-design carpet tiles or a prequalified alternate tile. No substitutions will be considered after the award of Contract.

2.02 PERFORMANCE REQUIREMENTS

- A. Static-Dissipative Properties: Carpeting shall be manufactured in accordance with industry-specific static-control standards Motorola R56 or ATIS-0600321, for mission critical/telecommunications facilities.
 1. Carpeting shall prevent the accumulation of static without requiring use of specialty ESD footwear.
 2. Electrical Resistance: Carpeting material shall measure greater than 10 megohms (1.0×10^6 ohms) and less than 1000 megohms (1.0×10^8 ohms) when tested per ANSI/ESD STM7.1.
 3. Static Generation: Less than 100 V when tested per AATCC Test Method 134 or ANSI/ESD STM97.2 at 20 percent relative humidity with conductive footwear.
 4. Static Decay: 5000 to zero V in less than 0.25 seconds when tested per MIL STD 3010, Method 4046.
 - B. Critical Radiant Flux: All carpet tiles shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with ASTM E648 or NFPA 253.
-

2.03 MATERIALS

- A. Electrostatic Dissipative Tile Carpeting, Type C-TILE-B: Tufted, type 6,6 nylon, wrapped with electrically conductive fibers.
 - 1. Product: ShadowFX Static-Dissipative ESD Carpet Tile manufactured by StaticWorx.
 - 2. Tile Size: 24 by 24 inch, nominal. Verify size with submitted access flooring panel size.
 - 3. Color and Pattern: As selected by Architect from manufacturer's full range.
 - 4. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - 5. Gauge: 1/12 inch.
 - 6. Stitches: 9 per inch.
 - 7. Backing Material: Manufacturer's standard layered backing; conductive primary backing, with conductive carbon-loaded fiberglass, and static-dissipative PVC bottom backing.

2.04 ACCESSORIES

- A. Grounding: Provide grounding path in accordance with manufacturer's requirements. Coordinate with access flooring manufacturer to ensure grounding system connects to a designated building or electrical ground.
 - 1. Grounding Connectors: 5 mm, 26 gauge copper strip. Provide a minimum of 1 ground connector per 1000 square feet of ESD flooring, and not less than one per room, unless otherwise required by manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer for substrate indicated; static-control type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Access Flooring: Remove protective films, oils, and other coatings that may impair adhesion of carpet tile to access flooring panels in accordance with manufacturer's recommendations.
- C. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- D. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Install grounding strips in static-control adhesive in accordance with manufacturer's standards and per approved shop drawings. Install to acceptable ground connections.

- D. Blend carpet from different cartons to ensure minimal variation in color match.
- E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated.
- G. Locate change of color or pattern between rooms or at transitions to other finish flooring material directly under the door leaf centerlines, or at the center of cased openings.
- H. Fully adhere carpet tile to substrate.
- I. Install carpet tile into wall recesses, knee spaces under cabinets or countertops, closets, and other similar spaces.
- J. Trim carpet tile neatly at walls and around interruptions.
- K. Complete installation of edge strips, concealing exposed edges.

3.04 FIELD QUALITY CONTROL

- A. Field Testing: Contractor shall engage a third-party testing agency to test the electrical resistance of installed static-dissipative flooring.
 - 1. Electrical Resistance: Flooring shall average greater than 10 megohms (1.0×10^6 ohms) and less than 1000 megohms (1.0×10^8 ohms) when tested as a floor covering system (including flooring materials and standard non-specialty footwear) in combination; in accordance with ANSI/ESD STM97.2.

3.05 CLEANING AND PROTECTION

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.
- C. Protect installed carpet in accordance with CRI 104, Section 13.7 "Post Installation."

END OF SECTION 096813.13

**SECTION 096900
ACCESS FLOORING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. CISCA (AF) - Recommended Test Procedures for Access Floors.
- D. ICC (IBC) - International Building Code.
- E. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- F. NFPA 75 - Standard for the Fire Protection of Information Technology Equipment.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's data sheets including loading capacities, materials, finishes, dimensions of components, profiles, and accessories.
- B. Shop Drawings: Indicate floor layout, appurtenances or interruptions, edge details, ramps.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Designer's Qualification Statement.
- E. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design floor system structure layout for this project under direct supervision of a Professional Structural Engineer experienced in design of floors of the type required and licensed in the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing the type of work required in this section and approved by access flooring manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Access Flooring - Adjustable Height:
 - 1. ASM Modular Systems, Inc.
 - 2. Global IFS.
 - 3. Tate Access Floors, Inc.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Comply with the following system requirements and as indicated for specified components.
 - 1. Test in accordance with CISCA (AF).
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Structural Design Live Loads: Comply with requirements of ICC (IBC).

4. Lateral Stability: Design system for lateral stability in all directions, with or without panels in place.
- B. Concentrated Load: Over an area of 1 inch by 1 inch, 1250 pounds at any location, when tested in accordance with CISCA (AF).
 1. Maximum Deflection: 0.1 inch.
 2. Permanent Deformation: 0.02 inch maximum at design load.
- C. Ultimate Load: Over an area of 1 inch by 1 inch: Not less than twice design load or 2500 pounds, when tested in accordance with CISCA (AF).
- D. Rolling Loads: Permanent deformation not to exceed 0.04 inch, when tested in accordance with CISCA (AF).
 1. Wheel A: 10 passes, with loading of 500 pounds.
 2. Wheel B: 10,000 passes, with loading of 500 pounds.
- E. Drop Impact Load: 150 pounds, when tested in accordance with CISCA (AF).
- F. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 75, maximum; when tested in accordance with ASTM E84.
- G. Electrical Grounding Connection: Listed and classified by Underwriters Laboratories as suitable for the purpose specified and indicated.

2.03 ACCESS FLOORING - ADJUSTABLE HEIGHT

- A. Factory-fabricated system consisting of removable floor panels and supporting understructure that allows access to space below floor without requiring removal of panels other than the one directly above the space to which access is needed; provide components and accessories required for complete installation.
- B. Finished Floor Elevation: Top of access floor 8 inches nominal height above building structural floor.
- C. Configuration:
 1. Snap-on panels on stringerless understructure.
- D. Components:
 1. Pedestal Assembly:
 - a. Material: Steel.
 - b. Finish: Galvanized.
 - c. Base: Manufacturer's standard shape and size in accordance with system performance requirements.
 - d. Column: Threaded supporting rod to permit 1-1/2 inch adjustment.
 - e. Head: Manufacturer's standard shape and size to accept specified configuration.
 - f. Maximum Pedestal Axial Load: 5000 pounds without permanent deformation, when tested in accordance with CISCA (AF).
 2. Floor Panels:
 - a. Construction:
 - 1) Concrete core laminated with sheet steel plates.
 3. Floor Covering: Field applied, as indicated.

2.04 ACCESSORIES - ADJUSTABLE HEIGHT

- A. Perimeter Pedestals: Provide manufacturer's standard perimeter accessory pedestal, sized to required height, where panels must be cut and standard lock-in pedestal is not applicable.
 - B. Electrostatic Grounding Connectors: Solid copper.
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- C. Cable Cutout Protection: Manufacturer's standard type, self-extinguishing.
- D. Sealant: Any water-based, moisture-curing, or chemically-curing joint sealant suitable for purpose and compatible with materials being sealed; except acrylic latex emulsion.

2.05 FABRICATION

- A. Fabrication Tolerances:
 - 1. Floor Panel Flatness: Plus or minus 0.02 inch in any direction.
 - 2. Floor Panel Width or Length From Specified Size: Plus or minus 0.02 inch.
 - 3. Floor Panel Squareness: Plus or minus 0.03 inch difference between opposite diagonal dimensions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements are as indicated on shop drawings.
- B. Verify that substrates comply with tolerances, dimensioned clearances, and other requirements specified in other sections, and that substrates are clean, dry, and free of conditions and deleterious substances that might interfere with system installation.
- C. Verify that required utilities are available, in proper location, and are ready for use.
- D. Start of installation constitutes acceptance of project conditions.

3.02 PREPARATION

- A. Vacuum clean substrate surfaces.

3.03 INSTALLATION - ADJUSTABLE HEIGHT ACCESS FLOORING

- A. Install components in accordance with manufacturer's instructions.
- B. Secure pedestal base plate to subfloor with adhesive.
- C. Install additional pedestals where grid pattern is interrupted by room appurtenances or at cut-outs.
- D. Install floor panels on pedestals with full bearing.
- E. Close field cut floor panels with edge trim.
- F. Cut holes in floor panels to accommodate Owner equipment as indicated on drawings. Provide cable cut-out protection.
- G. Provide floor with edge trim and end closures. Provide lateral braces at stair edges and other locations where pedestals are not braced.
- H. Provide positive electrical earth grounding of entire floor assembly in accordance with NFPA 75.

3.04 TOLERANCES

- A. Maximum Out of Level Floor Panel Tolerance: 1/16 inch in 10 ft, non-cumulative.

3.05 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

3.06 ADJUSTING

- A. Adjust pedestals to achieve a level floor and to assure adjacent floor panel surfaces are flush.

3.07 PROTECTION

- A. Do not permit traffic over unprotected floor surface.

END OF SECTION 096900

SECTION 098414
ACOUSTIC STRETCHED-FABRIC WALL AND CEILING SYSTEMS

PART 1 GENERAL

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.
- B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
- E. ASTM E2573 - Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Specimen warranty.
- B. Shop Drawings: Details indicating typical transitions to other finish surfaces and elevations indicating proposed locations of fabric seams.
 - 1. Include mounting and attachment details, and details at edges, corners and other special conditions.
- C. Selection Samples: Fabric swatches representing manufacturer's full range of available colors, textures, and patterns.
- D. Test Reports: Certified test data from an independent test agency verifying that wall systems meet specified requirements for acoustical and fire performance.
- E. Installer's Qualification Statement.
- F. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified; trained or certified by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect fabric, acoustical backing, and track from excessive moisture in shipment, storage, and handling.
- B. Do not deliver materials to project until wet work such as concrete and plaster has been completed.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.05 FIELD CONDITIONS

- A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during occupancy.
- B. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Stretched-Fabric Wall Systems:
 - 1. Accutrack Systems.
 - 2. Conwed.
 - 3. Fabric Wall.
 - 4. Fabricmate Systems.
 - 5. FabriTRAK Systems, Inc.
 - 6. Novawall Systems, Inc.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 ACOUSTIC STRETCHED-FABRIC SYSTEM

- A. Acoustic Stretched-Fabric System: Field installed, fabric is stretched and set into framework and laid over acoustic material anchored to substrate. Framework consists of continuous perimeter and intermediate mounting frames anchored to substrate, and designed to permit removal and replacement of fabric within framed areas without affecting adjacent areas.
 - 1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84 using mounting specified in ASTM E2573 for stretched systems.
 - a. Surface Burning Characteristics tested by ASTM E 2573 shall be for the complete assembly, including framing extrusions, core material, and fabric covering.
 - 2. Noise Reduction Coefficient (NRC): 0.80, minimum, when tested in accordance with ASTM C423, Type A mounting per ASTM E795.
 - 3. Prefabricated, fabric covered and individually framed panels are not permitted.
 - 4. Install fabric over acoustic material and into framework without use of adhesives, tapes, or fasteners.
 - 5. Seams: Provide minimal seaming. Where necessary, provide manufacturer's standard flat sewn seams. Provide as indicated on Drawings; where not indicated, obtain Architect's approval via shop drawings.

2.03 MATERIALS

- A. Frame: Extruded polymer framing system with serrated jaws of sufficient strength to hold fabric in place after repeated applications.
 - 1. Wall Frame Size: 1 inch height from wall substrate to match core thickness; with minimum 1 inch wide base.
 - a. Wall Frame Shape: Bevel at perimeter, and square at intermediate abutting joints.
 - b. Reveal: 1/2-inch.

- B. Acoustic Material:
 - 1. Provide type of acoustic material in thickness required to achieve Noise Reduction Coefficient (NRC) indicated.
 - 2. Ensure that thickness of acoustic material fills depth of frame as necessary for application without use of support blocking.
 - 3. Compressed Fiberglass Board: Class A fire rated in accordance with ASTM E84.
 - a. Overall Thickness: 1 inch.
 - b. Density: 6 to 7 lbs/cu ft.
- C. Rigid Blocking: Fire-retardant treated medium density fiberboard complying with ANSI A208.2, in thickness to meet project requirements.
- D. Fabric: Basis of Design is Maharam, Product Style "Muse 466487," 100% woven polyester fabric.
 - 1. Other Acceptable Manufacturers:
 - a. ArcCom.
 - b. Designtex.
 - c. Momentum.
 - 2. Color: Selected from full range available from basis-of-design style.
 - 3. Width: 54 inch minimum.
- E. Fasteners: As recommended by manufacturer of acoustic stretched-fabric system in accordance with project requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Begin installation only after substrates have been properly prepared.
- B. Verify that casework, markerboards, door and window jambs, finished ceiling, and other finished items adjacent or abutting the acoustic stretched-fabric system have been properly installed.
- C. When preparation of substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation prior to proceeding with this work.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation of this work.
- B. Prepare substrate surfaces using methods as recommended by the manufacturer for achieving acceptable result as required for this work.
- C. Remove wall plates and other obstacles, and properly prepare substrates to receive frames and acoustic material in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install acoustic stretched-fabric system at locations indicated in accordance with approved shop drawings and manufacturer's instructions.
- B. Frames: Install perimeter and intermediate frames using appropriate fasteners for prepared substrate, firmly secured to ensure frames do not separate from substrate.
 - 1. For tile or masonry substrates, apply continuous bead of adhesive along base of framing in addition to spacing of conical anchors and/or fasteners at 6 to 8 inches on center.

2. Follow contours of wall and scribe to adjoining work at borders, penetrations, and imperfections.
 3. Install framing around openings and penetrations.
 4. Allow for spacing of framework to accommodate insertion of installation tool.
- C. Acoustic Material: Cut and trim acoustic material to fit snugly within perimeter and intermediate framework.
1. Apply adhesive and press acoustic material into place, maintaining constant plane.
 2. At fixtures mounted within areas of acoustic stretched-fabric system, install rigid blocking for backing and maintain plane of fixture surface flush with face of acoustic stretched-fabric system.
- D. Fabric: Stretch fabric over acoustic material, locking edges of fabric into frame's serrated jaws using manufacturer's recommended tool. Maintain fabric weave plumb, level and true, in proper relation to building lines, without ripples, waviness, hourglass, or other deleterious effects.
1. Upon fabric installation, do not employ adhesives or mechanical fasteners of any type, and ensure fabric is free-floating and in contact with acoustic material as necessary.
 2. Stapling or gluing of fabric to cores or channel framework is not permitted.
 3. Provide tension in fabric sufficient to prevent sagging under anticipated changes in temperature and humidity.
 4. At outside corners, wrap as single piece of fabric without joints, seams, or visible framing; unless otherwise indicated.

3.04 CLEANING

- A. Clean exposed surfaces of acoustic stretched-fabric system in compliance with manufacturers instructions for cleaning and repair of minor damage to exposed surfaces.
- B. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage to system.

3.05 PROTECTION

- A. Protect installed materials upon completion of this work, using methods that will ensure that the finished work is without damage or deterioration upon Date of Substantial Completion.

END OF SECTION 098414

**SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's printed data sheets for products specified.
- B. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.
- C. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
- D. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a two-year period for failure of materials or workmanship commencing on the Date of Substantial Completion.
 - 1. Failures include but are not limited to acoustic performance, fabric separation from core or fabric sagging, panel distortion or warping.

PART 2 PRODUCTS

2.01 WOOD FIBER SOUND-ABSORBING UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc; Tectum Direct-Attach.
 - 2. Cardinal Acoustics; Direct Attached Panel.
 - 3. Conwed; Arborcoustic.
- B. Wood Fiber Acoustical Panels for Walls: Cementitious wood fiber.
 - 1. Size: As indicated on Drawings.
 - 2. Thickness: 1 inch.

3. Noise Reduction Coefficient (NRC): 0.80 minimum when tested in accordance with ASTM C423 for Type C-20 mounting, per ASTM E795.
4. Panel Edge: Beveled.
5. Surface Pattern: Coarse.
6. Surface Color: Factory-painted custom colors to match architect's selections.
7. Installation Method (Wall): Direct-attached over 1 inch depth furring strips and 3 lb rigid/semi-rigid glass fiber acoustic board.
 - a. Furring Strips: 1 inch depth wood furring.
 - b. Fiberboard Insulation: Rigid/semi-rigid mineral fiber, ASTM C612, unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

2.02 FABRICATION

- A. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

- A. Furring Strips: 1 by 2 inch wood furring.
- B. Fiberglass: 3 lb density.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Install mounting accessories and supports in accordance with shop drawings.
- C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- D. Furring-Mounted Cementitious Wood Fiber Panels:
 1. Install furring strip along meeting edges of adjacent panels to ensure they are attached to same furring strip along abutted edge; 24 inches on center, maximum.
 2. Install acoustic insulation between furring as indicated on drawings.
 3. Adhere first panel from edge to furring strip; attach subsequent panels using fasteners.
- E. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 1. Plumb and level.
 2. Flatness.
 3. Width of joints between panels; where applicable.

3.03 CLEANING

- A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
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- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION 098430

**SECTION 099100
PAINTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior and interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated. Specific items include (but are not limited to) the following:
 - 1. Fire- and Smoke-Rated Wall Identification: Permanently label fire- and smoke-rated walls, partitions, and barriers per requirements of applicable building code. Labeling shall include fire-resistance rating, type of assembly, and instruction to protect openings/penetrations. Example text: "ONE HOUR FIRE BARRIER - PROTECT ALL OPENINGS".
 - a. Locate lettering in concealed accessible floor, floor-ceiling plenums, and attic spaces, located no more than 15 feet from end of wall and at horizontal intervals not exceeding 30 feet, with stenciled lettering not less than 3 inches high with minimum 3/8-inch strokes. Locate directly inside of access doors or panels that provide access to rated walls. Do not paint walls where exposed to view except in support spaces (mechanical / electrical rooms and similar spaces).
 - 2. Refer to the life safety plans and partition schedule on the drawings for rated wall and partition locations.
 - 3. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 4. Elevator pit ladders.
 - 5. Prime surfaces to receive wall coverings.
 - 6. 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. 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.
 - c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 - 7. Shop-Primed Items: In finished areas, paint shop-primed items. Unless specifically indicated that additional field primer is not required, provide a tie coat primer over the shop primer before top coat(s) are applied.
- D. 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. Brick, architectural concrete, architectural precast, cast stone, and integrally colored plaster, fiberglass, or stucco.
10. Glass.
11. Acoustical materials, unless specifically indicated.
12. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- C. SSPC-SP 1 - Solvent Cleaning.
- D. SSPC-SP 6 - Commercial Blast Cleaning.

1.03 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 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.

1.05 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 materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints:
 1. Benjamin Moore.

2. PPG Paints.
3. Sherwin-Williams Company.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended 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. Supply each paint material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Low-Emitting Materials (Paints and Coatings): Paints and coatings field-applied inside the weatherproofing system shall be tested and determined compliant in accordance with CAL (CDPH SM) AND shall meet applicable VOC limits of CARB (SCM) or SCAQMD 1113.

2.03 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

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 1. Gypsum Wallboard: 12 percent.

3.02 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 repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. 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.
- G. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- J. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. 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.

3.03 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. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Sand wood and 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.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.06 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following Paint systems for the various substrates, as indicated. Dry film thickness is noted as "DFT." Provide compatibility test areas on existing painted substrates.
- B. Zinc-Coated or Zinc-rich Primer-Coated Metal with Direct to Metal ("DTM") Gloss Acrylic Enamel Finish: 2 topcoats of DTM gloss enamel over primer, with min. total DFT of 2.5 mils.
 1. Prime Coat (Tie-Coat): Lead-free, acrylic base interior/exterior galvanized metal primer, premium grade. Apply over shop primer.
 - a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
 - b. PPG: 90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel.
 - c. S-W: B66 Pro-Cryl Universal Primer.
 2. First and Second Coats: DTM Acrylic Gloss Enamel.

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- a. Moore: HP28 Ultra Spec HP Acrylic Gloss Enamel.
 - b. PPG: 90-1310 Pitt-Tech Plus Int/Ext High Gloss DTM Industrial Enamel.
 - c. S-W: B66W1050 Series Pro Industrial DTM Acrylic Coating (Gloss).
- C. Field-Applied Coatings for Ferrous Metal (AESS): Aliphatic urethane system of intermediate coat and topcoat. Provide scheduled products for exposed steel fabrications indicated as AESS.
- 1. Field Touch-up: Match moisture curing urethane zinc-rich shop primer.
 - 2. Intermediate Coat: Moisture curing urethane and micaceous iron oxide or epoxy.
 - a. Moore: Corotech V160 Epoxy Mastic Coating.
 - b. PPG: 95-245 Pitt-Guard Rapid Coat D-T-R Epoxy Coating.
 - c. S-W: Macropoxy 646 Fast Cure Epoxy, B58-600/B58v600.
 - 3. Top Coat: Aliphatic urethane at 2.0 – 3.0 mils DFT.
 - a. Moore: Corotech V500 Aliphatic Acrylic Urethane.
 - b. PPG: 95-812 Pitthane Ultra Gloss Urethane Enamel.
 - c. S-W: Corothane I Aliphatic Finish Coat B65.
- D. Concrete: Acrylic latex satin finish, two finish coats over alkali-resistant primer with minimum total DFT of not less than 3.5 mils.
- 1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
 - a. Moore: 608 Ultra Spec Masonry Int/Ext 100% Acrylic Sealer/Primer.
 - b. PPG: 4-603 Perma-Crete Int/Ext Alkali Resistant Primer.
 - c. S-W: A24w8300, Loxon Concrete & Masonry Primer.
 - 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A82 Series A-100 Exterior Latex Satin.
- E. Concrete Masonry Units: Acrylic latex satin finish, two finish coats over primer with minimum total DFT of not less than 3.5 mils.
- 1. Prime Coat: Exterior Acrylic weathered masonry sealer/primer.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.
 - c. S-W: A24W200 Loxon Block Surfacer.
 - 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A 82 Series A-100 Exterior Latex Satin.
- F. Exterior Gypsum Soffit Board with Smooth Finish 100% Acrylic Coating: Top coat(s) for total DFT of 10.0 mils minimum over primer-sealer.
- 1. Prime Coat (Tie-Coat): Bonding primer-sealer.
 - a. Moore: N023 Fresh Start All Purpose 100% Acrylic Int/Ex Latex Primer.
 - b. PPG: 6-9 Speedhide Exterior Wood Primer Oil.
 - c. S-W: B51-450, Multi-Purpose Primer.
 - 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim. Satin Latex 100% Acrylic.
 - c. S-W: A82 Series A-100 Exterior Latex Satin.

3. First and Second Finish Coats: Exterior 100% Acrylic – Flat finish; premium grade.
 - a. Moore: N400 Regal Select Exterior Paint High Build Flat Finish.
 - b. PPG: 72-45 Sun-Proof Ext House & Trim. Flat Latex 100% Acrylic
 - c. S-W: A6 Series A-100 Exterior Latex Flat
- G. General Painted Wood and Plywood with Acrylic Latex Satin Finish: 2 finish coats over primer with total DFT not less than 3.5 mils.
 1. Prime Coat: Alkyd-based wood sealer/primer.
 - a. Ben Moore: 024 Fresh Start Multi-Purpose Oil Based Primer.
 - b. PPG: 6-9 Speedhide Exterior Wood Primer
 - c. S-W: Y24W8020 Exterior Oil Wood Primer.
 2. First and Second Finish Coats: Exterior 100% Acrylic – Satin sheen; premium grade.
 - a. Moore: N401 Regal Select Exterior Paint High Build Low Lustre Finish.
 - b. PPG: 76-45 Sun-Proof Ext House & Trim, Satin.
 - c. S-W: A82 Series A-100 Exterior Latex Satin.

3.07 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as “DFT.” Provide compatibility test areas on existing painted substrates.
- B. Concrete Masonry Units: Low-VOC Acrylic Satin Finish. 2 Coats over filler, with total DFT not less than 2.5 mils. (Provide for CMU except where “epoxy finish” is indicated.)
 1. Filler Coat, 100% Acrylic. Apply filler coat at a rate to ensure complete coverage. Brush, spray or roller apply and back roll or squeegee for smooth, pinhole-free treatment.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 16-90 Pitt Glaze WB Acrylic Interior Exterior Block Filler.
 - c. S-W: B42W46 Heavy Duty Block Filler. (PrepRite not acceptable)
 2. Waterproofing Filler Coat – Showers & Wet Applications: Cementitious resin or epoxy block filler applied by brush, spray or roller and back rolled or squeegeed for smooth, pinhole-free treatment.
 - a. Moore: P31 Waterborne Epoxy Block filler.
 - b. PPG: 95-217 Epoxy Ester Cementitious Waterproofing Block Filler.
 - c. S-W: B42W400/B42V401 Kem Cati-Coat HS Epoxy Filler/Sealer.
 3. Bonding Primer (previously painted): Acrylic bonding primer for exceptional adhesion to hard, glossy surfaces. Test for adhesion. Brush, spray or roller apply and back roll.
 - a. Moore: Stix Bonding Primer.
 - b. PPG: 17-921 PPG Seal Grip Acrylic Universal Primer/Sealer.
 - c. S-W: B51W150 Extreme Bond Interior/Exterior Primer.
 4. First & Second Finish Coats: Commercial Interior Low-VOC Acrylic Satin Finish. Provide for wall finishes unless directed otherwise.
 - a. Moore: N538 Ultra Spec 500 Interior Eggshell Finish.
 - b. PPG: 6-4300 Speedhide Zero VOC Interior Eggshell Latex.
 - c. S-W: B20-2600 ProMar 200 Zero VOC Interior Latex Eg-Shel.
- C. Concrete Masonry Units - Semi-Gloss Water-Borne Epoxy Finish: 2 Coats over filler:
 1. Block Filler Coat: Acrylic-latex or as required by manufacturer for topcoat. Brush, spray or roller apply and back roll for smooth pinhole-free treatment.
 - a. Moore: 571 Ultra Spec Hi-Build Masonry Block Filler.
 - b. PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler.

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- c. PPG: 16-90 Pitt-Glaze WB Int/Ext Block Filler Latex.
 - d. S-W: B42W46 Heavy Duty Interior/Exterior Block Filler.
 2. First and Second Coats: Two-component, semi-gloss water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat.
 - a. Moore: Corotech V400 Polyamide Epoxy Coating.
 - b. PPG: 98-100 Aquapon WB Water Base Epoxy – Semi-Gloss.
 - c. S-W: B73V300 Pro Industrial Water Based Catalyzed Epoxy Hardener.
- D. Concrete Floor with Epoxy Floor-Striping Enamel at Vehicle Bays: 2 Coats over primer on cured surface. Concrete must cure a minimum of 30 days before painting and have pH of 10.0 or lower. Prepare floor by means acceptable to paint manufacturer (accepted in writing) prior to painting.
 1. Primer Coat: Epoxy primer applied over prepared concrete.
 - a. Moore: Corotech V155-00 100% Solids Epoxy Pre-Primer.
 - b. PPG: Amerlock 2/400 Series primer.
 - c. S-W: Macropoxy 646 Fast Cure (FC) Epoxy.
 2. Two Finish Coats: Two-component high solids epoxy floor enamel for traffic surface. Provide 4.0 - 8.0 mils DFT per coat or as recommended by manufacturer.
 - a. Moore: Corotech V440 Waterborne Amine Epoxy.
 - b. PPG: Amerlock 2.
 - c. S-W: Macropoxy 646 Fast Cure (FC) Epoxy.
- E. Gypsum Board Systems with Latex Finish: Satin (egg-shell) finish at walls and flat finish on ceilings except as indicated otherwise. Provide best commercial Low-VOC formulation with 0 VOC per EPA test method 24.
 1. Filler Coat: 0 VOC (per EPS test method 24) Latex Primer.
 - a. Moore: N534 Ultra Spec 500 Interior Latex Primer.
 - b. PPG: 6-4900 Speedhide Zero VOC Interior Latex Primer.
 - c. S-W: B28-2600 ProMar 200 Zero VOC Interior Latex Primer.
 2. First & Second Finish Coats: Interior Low-VOC Acrylic Satin Finish. (Low lustre/Satin = 25-45% @60°) Provide for wall finishes unless indicated otherwise.
 - a. Moore: N538 Ultra Spec 500 Interior Eggshell.
 - b. PPG: 6-4300 Speedhide Zero VOC Interior Eggshell Latex.
 - c. S-W: B20-2600 ProMar 200 Zero VOC Interior Latex Eg-Shell.
 - d. S-W: B24-2600 ProMar 200 Zero VOC Interior Latex Low Sheen.
 3. First & Second Finish Coats: Interior Low-VOC Acrylic Flat Finish. Provide for ceiling applications unless indicated otherwise.
 - a. Moore: N536 Ultra Spec 500 Interior Flat.
 - b. PPG: 6-4100 Speedhide Zero VOC Interior Latex Flat.
 - c. S-W: B30-2600 ProMar 200 Zero VOC Interior Latex Flat.
- F. Gypsum Board Systems with Water-Borne Polyamide Epoxy Finish (“EPX”):
 1. Filler Coat: Manufacturer’s recommended primer.
 - a. Moore: 217 Fresh Start Alkyd Enamel Underbody.
 - b. PPG: 6-2 Speedhide Interior Latex Sealer.
 - c. S-W: B28W2600 ProMar 200 Zero VOC Primer.
 2. First and Second Coats: Two-component, water born polyamide epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat. Provide semi-gloss finish unless directed otherwise.
 - a. Moore: Corotech V440 Waterborne Amine Epoxy.

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- b. PPG: 98-100 Aquapon WB Water Base Epoxy – Semi-Gloss.
 - c. S-W: B70 Series B60V25 Water Based Catalyzed Epoxy.
- G. Ferrous Metal with Latex Dry Fog Finish: One finish coat over primed exposed construction. Provide nominal 50 square foot sample area to test for paint compatibility with substrates.
- 1. Prime Coat: (Acrylic or recommended VOC-compliant metal primer for surfaces not pre-primed.) 2.0 mils DFT.
 - a. Moore: N110 Superkote 5000 DryFall latex Flat.
 - b. PPG: 90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel.
 - c. S-W: B66-310 Pro-Cryl Universal Primer.
 - 2. Top Coat: All exposed structure as scheduled. Acrylic Dry Fog 3.0 mils DFT. Provide color finish as selected by Architect from manufacturer's full range.
 - a. Moore: N110 Superkote 5000 DryFall Latex Flat.
 - b. PPG: 6-724XI Series Speedhide Super Tech WB Int. Dry-Fog Flat Latex Flat.
 - c. S-W: B42 BW3 Waterborne Acrylic Dry Fall, Flat.
- H. Ferrous Metal: Direct to Metal (“DTM”) Acrylic Enamel Finish: 2 Coats over primer, with total DFT not less than 2.5 mils. Provide satin finish at hollow metal steel doors and frames, and semi-gloss at other applications.
- 1. Prime Coat: Lead-free, acrylic Base Primer. Not required on shop primed items.
 - a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
 - b. PPG: 90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel.
 - c. S-W: B66 W1 DTM Acrylic Primer/Finish (or B66 W200).
 - 2. Bonding Primer (previously painted): Acrylic bonding primer designed for previously painted ferrous metal to ensure secure bond. Brush, spray or roller apply and back roll.
 - a. Moore: SXA-110 Insl-X Waterborne Bonding Primer.
 - b. PPG: 90-912 Pitt-Tech Plus DTM Industrial Primer.
 - c. S-W: B66A50 DTM Bonding Primer.
 - 3. First and Second Coat: DTM Acrylic Semi-Gloss Enamel. (30-40 units @ 60°)
 - a. Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss.
 - b. PPG: 90-1210 Pitt-Tech Int/Ext Semi-Gloss DTM Industrial Enamel.
 - c. S-W: B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating.
 - 4. First and Second Coat: DTM Acrylic Satin Enamel. Provide for hollow metal steel doors and frames. (15-25 units @ 60°)
 - a. Moore: HP25 Ultra Spec HP DTM Acrylic Low Lustre.
 - b. PPG: 90-1110 Pitt-Tech Int/Ext Satin DTM Industrial Enamel.
 - c. S-W: B66W1250 Series Pro Industrial DTM. Acrylic Eg-Shel.
- I. Zinc-Coated Metal: Semi-Gloss Direct to Metal (“DTM”) Acrylic Enamel Finish: 2 Coats over primer, with min. total DFT of 2.5 mils.
- 1. Prime Coat: Lead-free, acrylic base interior galvanized metal primer, premium grade.
 - a. Moore: HP04 Ultra Spec HP Acrylic Metal Primer.
 - b. PPG: 90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel.
 - c. S-W: B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating.
 - 2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel. Same as for ferrous metal.
- J. Stained woodwork with transparent finish is specified in Division 6 Sections by woodworker.

END OF SECTION 099100

**SECTION 101100
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard.
- B. ANSI A208.1 - American National Standard for Particleboard.
- C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling.
- D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.

1.02 SUBMITTALS

- A. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- B. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- C. Test Reports: Show compliance to specified surface burning characteristics requirements.
- D. Maintenance Data: Include data on regular cleaning, stain removal.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Factory-fabricate visual display units and deliver as fully assembled units to greatest extent possible.
- B. Deliver and store visual display units with protective packaging. Do not remove protective covers until ready to install.
- C. Store visual display units in a dry, enclosed space. Do not install until installation spaces are enclosed and conditioned at occupancy conditions.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide fifty year warranty for markerboard porcelain face surface to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

- A. Porcelain Enamel Steel Markerboards: Magnetic, porcelain-enamel steel face sheet bonded to manufacturer's standard core. Provide with foil backer where mounted to exterior walls.
 - 1. Color: White.
 - 2. Height: 48 inches, unless otherwise indicated on Drawings.
 - 3. Length: As indicated on Drawings.
 - 4. Frame: Extruded aluminum, with concealed fasteners.
 - 5. Frame Finish: Anodized, natural.
 - 6. Accessories: Provide marker tray and map rail.
 - 7. Products:
 - a. AARCO Products, Inc.
 - b. ASI Visual Display Products.
 - c. Bangor Cork Company, Inc.

- d. Claridge Products and Equipment, Inc.
- e. Ghent; a GMI Company.
- f. Marsh Industries, Inc; Visual Products Group.
- g. MooreCo, Inc.
- h. Nelson Adams NACO.
- i. Platinum Visual Systems.
- j. Polyvision Corporation.

2.02 MATERIALS

- A. Porcelain Enamelled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Fiber Board: ASTM C208, cellulosic fiber board.
- E. Foil Backing: Aluminum foil sheet, 0.005 inch thick. Provide foil backing on units indicated to be mounted on exterior walls.
- F. Adhesives: As recommended by manufacturer.

2.03 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall , full width of frame.
- B. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- C. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.
- E. Mounting Accessories and Fasteners: Provide concealed Z-clips and hangers, and stainless steel screws or anchors for mechanical attachment of visual display units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 36 inches above finished floor.
- C. Secure units level and plumb.

- D. Mechanical Fastening: Install all visual display units for secure attachment with manufacturer's recommended concealed clips, hangers, and mechanical fasteners. Installation with adhesive is not acceptable.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION 101100

**SECTION 101400
SIGNAGE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.
- B. ADA Standards - 2010 ADA Standards for Accessible Design.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Allowance: Interior and exterior panel signage shall be covered by allowance; refer to Section 012100 - Allowances.
- B. Pre-Fabrication Meeting: The signage contractor shall meet with representatives of the Owner to develop a Signage Schedule, including signage style and layout, individual sign locations, including locations of code required signage and wayfinding signage, and final room naming and numbering. The Architect will provide the graphics contractor with reproducible floor plan drawings for use in determining sign locations.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule (After Pre-Fabrication Meeting): Submit schedule with information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. Submit for approval by Owner through Architect prior to fabrication.
- C. Selection Samples: Where colors are not specified, submit color selection charts or chips for each type of signage.
- D. Verification Samples: Submit samples, manufacturer's standard size, showing selected colors for each type of signage.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most

comprehensive and specific requirements.

- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Toilet room signage shall include pictograms and international symbol of accessibility.

2.02 PANEL SIGNAGE TYPES

- A. General: Interior and exterior panel signage shall be provided via lump-sum allowance; refer to Division 1 Section "Allowances."
 - B. Manufacturers:
 - 1. Allen Industries Architectural Signage.
 - 2. APCO Graphics, Inc.
 - 3. ASI-Modulex, Inc.
 - 4. Best Sign Systems, Inc.
 - 5. Gemini Incorporated.
 - 6. Innerface Sign Systems, Inc.
 - 7. InPro Corporation.
 - 8. Matthews International Corporation, Bronze Division.
 - 9. Mohawk Sign Systems.
 - 10. Nelson-Harkins Industries.
 - 11. Seton Identification Products.
 - 12. The Supersine Company.
 - 13. Welch Sign.
 - 14. Substitutions: See Section 016000 - Product Requirements.
 - C. Photopolymer Panel Signage: Signage media without frame.
 - 1. Signage Material: 0.032-inch water wash photopolymer face layer over a 0.160-inch phenolic or 0.120-inch PETG base layer.
 - 2. Edges: Square.
 - 3. Corners: Square.
 - 4. Wall Mounting of One-Sided Signs: Tape adhesive.
 - a. For signs mounted to glass, such as at door sidelights, provide a rear cover plate so the backside of sign will not be visible through the glass.
 - 5. Tactile Signage: Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - D. Aluminum Panel Signage: Fabricate of minimum 0.063-inch aluminum sheet, without frame, with baked enamel finish. Wall mount with stainless steel fasteners in each corner. Not acceptable at locations requiring tactile signage.
 - E. Color and Font: Unless otherwise indicated, panel signage, font, and color shall be selected from manufacturer's full range.
 - F. Code-Required Signage: In addition to the room signage, provide panel signage required by accessibility regulations and requirements of authorities having jurisdiction, including, but not limited to, the following:
 - 1. Tactile exit signs, stairway identification signs, room maximum capacity signs, elevator signs, and accessible space signs.
 - 2. Refer to Division 26 and Electrical Drawings for illuminated exit signs.
-

2.03 PLAQUES

- A. Manufacturers:
 - 1. Advance Corporation; Braille-Tac Division.
 - 2. A.R.K. Ramos.
 - 3. Gemini Incorporated.
 - 4. Matthews International Corporation, Bronze Division.
 - 5. Metal Arts; Division of L&H Manufacturing Co.
 - 6. Mills Manufacturing Company.
 - 7. Nelson-Harkins Industries.
 - 8. The Southwell Company.
 - 9. Substitutions: See Section 016000 - Product Requirements.
- B. Metal Plaques:
 - 1. Metal: Bronze casting.
 - 2. Size: For bid purposes assume one 36 inch by 24 inch plaque, with a 6 inch diameter graphic logo / county seal (image to be provided by Owner) and raised text. Confirm final size and desired information, text, and typeface, with Owner.
 - 3. Surface Finish: Brushed, satin.
 - 4. Painted Background Color: As selected by Architect from manufacturer's standard background colors.
 - 5. Protective Coating: Manufacturer's standard clear coating.
 - 6. Mounting: Stud mounted, with concealed studs.

2.04 DIMENSIONAL LETTERS

- A. Manufacturers:
 - 1. A.R.K. Ramos.
 - 2. ASI-Modulex, Inc.
 - 3. Charleston Industries, Inc.
 - 4. Gemini Incorporated.
 - 5. Innerface Sign Systems, Inc.
 - 6. Matthews International Corporation, Bronze Division.
 - 7. Metal Arts; Division of L&H Manufacturing Co.
 - 8. Mills Manufacturing Company.
 - 9. Mohawk Sign Systems.
 - 10. Superior Signs.
 - 11. Substitutions: See Section 016000 - Product Requirements.
- B. Metal Letters:
 - 1. Metal: Aluminum casting.
 - 2. Letter Thickness: As indicated on drawings; if not indicated, provide as follows:
 - a. 6 inches high or less: 1/2 inch thick.
 - b. 7- to 11-inches high: 1 inch thick.
 - c. 12- to 17-inches high: 1-1/2 inches thick.
 - d. 18 inches high or more: 2 inches thick.
 - 3. Letter Height: As indicated on drawings.
 - 4. Text and Typeface: As indicated; where not indicated, as selected by Architect from manufacturer's full range of fonts.

5. Finish: Painted; color as selected by Architect from manufacturer's full range.
6. Mounting: Fabricate dimensional lettering for the following mounting types:
 - a. Projected Wall Mounted: Cast studs into the back of each letter for wall mounting at location indicated. Studs shall be sized to extend through cladding and fasten to structural substrate. Provide for a 1/2-inch gap between back of letter and face of cladding. Do not mount directly flush to wall surface.

2.05 ACCESSORIES

- A. Concealed Screws: Stainless steel, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
 1. Room Signs: Mount on latch side, with a clear space of 18 inches by 18 inches beyond the door swing arc, centered on the tactile characters. At double doors, mount to the right of right-hand leaf or on nearest adjacent wall. Mount at height that is compliant with ADA Standards.
- D. Mounting:
 1. Projected Wall Mounted: Cast studs into the back of each letter for wall mounting at location indicated. Studs shall be sized to extend through cladding and fasten to structural substrate. Provide for a 1/2-inch gap between back of letter and face of cladding. Do not mount directly flush to wall surface.
 2. Flush Wall Mounted: Cast studs into back of each letter for mounting to wall. Mount flush to wall surface with no gap behind letters.
- E. Mounting, Plaques:
 1. Mount plaques with manufacturer's standard concealed stud method; with anchors recommended specifically for wall/partition substrate structure indicated. Mount plaques flush to wall surface with no gap behind plaques.
- F. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 101400

SECTION 102113
METAL COMPARTMENTS / PARTITIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.02 SUBMITTALS

- A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports.
- B. Product Data: Provide data on panel construction, hardware, and accessories.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Stainless Steel Compartments/Partitions:
 - 1. All American Metal Corp - AAMCO.
 - 2. ASI Accurate Partitions.
 - 3. ASI Global Partitions.
 - 4. Bradley Corp.
 - 5. General Partitions Mfg. Corp.
 - 6. Hadrian
 - 7. Metpar Corp.
 - 8. Substitutions: Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Stainless Steel Sheet: ASTM A666, Type 304.

2.03 METAL PARTITIONS

- A. Locations: Provide metal partitions at all video visitation partitions.
- B. Compartment/Partition Style: Stainless steel, floor-mounted unbraced.
- C. Panels: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.
 - 1. Panel Faces: 20 gauge, 0.0359 inch.
 - 2. Reinforcement: 12 gauge, 0.1046 inch.
 - 3. Internal Reinforcement: Provide in areas of attached hardware and fittings.
- D. Panel Dimensions: Height and width as indicated on Drawings.
 - 1. Thickness: 1 inch.
 - 2. Height: 58 inch.

2.04 ACCESSORIES

- A. Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
- B. Brackets: Satin stainless steel, continuous full height of partition.

- C. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels to brackets: Through-bolts and nuts; tamper proof.

2.05 FINISHING

- A. Stainless Steel Compartments: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between walls and panels.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels to brackets.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust fittings and fasteners with adjacent components to ensure consistency of line or plane.

END OF SECTION 102113

**SECTION 102113.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.02 SUBMITTALS

- A. Product Data: Provide data on panel construction, hardware, and accessories.
 - 1. Provide data for wall anchors for attachment of wall brackets.
 - 2. Provide data substantiating that door latch product complies with accessibility standards.
 - 3. Provide data indicating NFPA 286 testing and compliance.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
 - 1. Include locations of plumbing fixtures and floor drains.
 - 2. Include accessible and ambulatory stalls, including stall and door clearances.
- C. Selection Samples: Submit color charts indicating manufacturer's full range of colors. Color charts shall indicate which colors are NFPA 286 compliant.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 15 year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. ASI Accurate Partitions.
 - 2. ASI Global Partitions.
 - 3. General Partitions Mfg. Corp.
 - 4. Scranton Products.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide HDPE panels tested per NFPA 286 and shown to meet the following criteria:
 - 1. During the 40 kW exposure, flames shall not spread to the ceiling.
 - 2. During the 160 kW exposure:
 - a. Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
 - b. Flashover, as defined in NFPA 286, shall not occur.

3. The peak rate of heat release throughout the NFPA 286 test shall not exceed 800 kW.
4. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m².

2.03 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
 1. Color: As selected by Architect from manufacturer's full range of NFPA 286 compliant colors.
 2. Doors:
 - a. Thickness: 1 inch.
 - b. Width: 24 inch.
 - c. Width for Handicapped Use: 36 inch, out-swinging.
 - d. Height: 55 inch.
 3. Panels:
 - a. Thickness: 1 inch.
 - b. Height: 55 inch.
 4. Pilasters:
 - a. Thickness: 1 inch.
 - b. Width: As required to fit space; minimum 3 inch.
 5. Urinal Screens: Wall mount (no post/pilaster). Match panel material and thickness; 42 inch height, and depth as indicated on Drawings.

2.04 ACCESSORIES

- A. Material for Hardware and Accessories: Provide stainless steel or anodized aluminum as indicated, with satin finish. Where not indicated, Contractor may provide either material at its option. Zamac is not acceptable.
- B. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
- C. Head Rails: Extruded aluminum, anti-grip profile.
 1. Size: Manufacturer's standard size.
- D. Wall and Pilaster Brackets: Anodized aluminum, minimum 0.125 inch wall thickness; continuous type; approximately 1 inch shorter than panel height.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Hinges: Coordinate hinges with latch and keeper to provide emergency access.
 1. Continuous-Type (Piano) Hinges (Heavy-Duty): Adjustable for door close positioning, with 1/8-inch pin of matching material. Provide spring-loaded self-closing type with five (5) adjustable internal springs at accessible, barrier-free, and outswinging doors, and provide gravity type with cam knuckles that can be adjusted to hold doors open at inswinging doors. Provide hinge length 1 inch shorter than door height.
- G. Door Hardware: Coordinate latch and keeper with hinges to provide emergency access.
 1. Door Latch (Heavy-Duty): Slide type, cast stainless steel with minimum 0.150-inch thickness slide bar, latch knob welded to slide bar.
 2. Door Strike and Keeper with Rubber Bumper (Heavy-Duty): Cast stainless steel, minimum 2.5-inch high with minimum 0.125-inch wall thickness, with integral rubber bumper. Mount on pilaster in alignment with door latch.

- 3. Provide a door pull on both sides of door for accessible and ambulatory compartments, in compliance with the ADA Standards for Accessible Design.
- H. Coat Hook with Rubber Bumper: One per compartment, mounted centered on inside face of door.
- I. Rubber Door Bumper: Mount in upper corner of latch side of outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.19

**SECTION 102123
CUBICLE CURTAINS AND TRACK**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 SUBMITTALS

- A. Product Data: Provide data for curtain fabric characteristics and for curtain track.
 - 1. Fire Test Data: Provide data indicating fabric is identical to that which has passed NFPA 701 and is inherently and permanently flame resistant.
- B. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes. Include above ceiling blocking.
- C. Selection Samples: Manufacturer's sample patches of pattern and colors for curtain and mesh fabrics.
- D. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.

PART 2 PRODUCTS

2.01 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; minimum 0.050-inch aluminum thickness; fabricated in one piece per track run, to greatest extent possible.
 - 1. Profile: Channel, nominal 1-1/4 inches wide by 3/4 inch high.
 - 2. Mounting: Surface.
 - 3. Structural Performance: Capable of supporting vertical test load of 50 lbs without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 - 4. Track End Stop: To fit track section.
 - 5. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
 - 6. Finish on Exposed Surfaces: Clear anodized.
 - 7. Products:
 - a. Construction Specialties; Traditional 6062 Track + 1062N carrier with ball chain/hook.
 - b. Inpro; Clickeze CE5000 track + CE5038 carrier with ball chain/hook.
 - c. Imperial Fastener Co.; IFC-98 track + IFC-100 carrier with ball chain/hook.
 - d. Salsbury Industries; 19100 series track + 19103 carrier with ball chain/hook.
- B. Curtain Carriers: Nylon rollers and 6 inch long beaded chain with aluminum hooks, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
- C. Installation Accessories: Types required for specified mounting method and substrate conditions.
 - 1. Provide stainless steel fasteners for exposed locations, and hot-dip galvanized fasteners for concealed locations.

2.02 CURTAINS

- A. Cubicle Curtains:
 - 1. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 - a. Fabric shall include identification markings from testing agency.
 - 2. Material: Close weave polyester; anti-bacterial, stain resistant, self deodorizing, sanitized, and preshrunk.
 - 3. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, to be selected by Architect from manufacturer's full range.
 - 4. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
 - 5. Products:
 - a. INVISTA; Avora FR.
 - b. Trevira; Trevira CS.
 - 6. Color/Pattern: To be selected by Architect from manufacturer's full range.
- B. Curtain Fabrication:
 - 1. Width of curtain to be 10 percent wider than track length.
 - 2. Length of curtain to end 15 inches above finished floor.
 - 3. Pattern match fabric with vertical seams.
 - 4. Include open mesh cloth at top 20 inches of curtain for room air circulation, attached to curtain as specified above.
 - 5. Curtain Heading: Web reinforced band of open mesh cloth with metal grommet holes for carriers spaced 6 inches on center.
 - 6. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.02 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line, per manufacturer's installation instructions.
- B. Secure track to ceiling system.
 - 1. Secure with mechanical fasteners to ceiling grids, not to exceed manufacturer's recommended spacing.
- C. Install end caps and stop devices, and provide splices and connector accessories as required for layout indicated.
- D. Install curtains on carriers ensuring smooth operation.

END OF SECTION 102123

**SECTION 102600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.

1.02 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- B. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures or internal connection failures.
 - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Babcock-Davis.
-

2. Construction Specialties, Inc.
 3. Inpro.
 4. Koroseal Interior Products.
 5. Nystrom, Inc.
 6. Substitutions: See Section 016000 - Product Requirements.
- B. Metal Crash Rails:
1. Alpar Architectural Products LLC.
 2. Construction Specialties, Inc.; SCR Series.
 3. Inpro
 4. Nystrom, Inc.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

2.03 PRODUCT TYPES

- A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
1. Mounting: Surface.
- B. Metal Crash Rails: Factory- or shop-fabricated, with preformed end wall returns, and internal and external corners:
1. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs at any point without damage or permanent set.
 2. Material: Metal; Stainless Steel, type 304.
 3. Mounting: Surface.
 4. Rail Type: Continuous metal bar.
 - a. Rail Profile: Rectangular, 1/4 inch by 5 1/2 inch, with eased edges.
 - b. Rail Configuration: Continuous line, with terminations only installed at doors, electrical panels, and fire-extinguisher cabinets, including items prohibited from being blocked by authorities having jurisdiction. Maintain rail continuity around all other wall configurations, protrusions, piers, abutments, and similar items. Rail and bracket layout to maintain typical projection dimension from wall to inside of rail, unless otherwise indicated.
 - c. Terminal ends, inside, and outside corners fabricated as an integral part of the rail.
 - d. Rail-to-Bracket Attachment: Aluminum studs welded to inside face of rail, with stainless steel serrated flange nut.
 - e. Return rail to wall.
 5. Finishes.
 - a. Stainless steel, No.4.
- C. Corner Guards - Surface Mounted:
1. Basis-of-Design Product: Construction Specialties; Acrovyn VA Series.
 2. Material: Polyethylene terephthalate (PET or PETG); PVC-free.
 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM

E84.

4. Width of Wings: 1-1/2 inches.
 5. Corner: Square.
 6. Color: To be selected by Architect from manufacturer's full range.
 7. Length: One piece, 6 feet (72 inches) in length.
- D. Corner Guards - Surface Mounted:
1. Basis-of-Design Product: Construction Specialties; Acrovyn CO Series.
 2. Material: Type 304 stainless steel, No. 4 finish, 16 gauge, 0.0625 inch thick.
 3. Width of Wings: 3 inches.
 4. Corner: Radiused.
 5. Length: One piece, 6 feet (72 inches) in length.
- E. Adhesives and Primers: As recommended by manufacturer.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Provide corner guards at all outside corners of gypsum board partitions, as indicated on Drawings.
- C. Position crash rail at height indicated on Drawings.
- D. Position corner guard with bottom of corner guard immediately above top of wall base.
- E. Terminate rails 1 inch short of door openings and intersecting walls.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

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- B. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

**SECTION 102800
TOILET AND BATH ACCESSORIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.03 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- C. Maintenance Data: For each type of accessory, to include in maintenance manual per Section 017800 - Closeout Submittals. Include list of replacement parts and service recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. A&J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment.
 - 4. Bradley Corporation.
- B. Under-Lavatory Pipe Supply Covers:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro; IPS Corporation.
- C. Baby Changing Stations:
 - 1. American Specialties, Inc.

2. Bradley Corporation.
 3. Diaper Deck & Company.
 4. Foundations Worldwide, Inc.
 5. Koala Kare Products.
 6. Safe-Strap Company, Inc.
- D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 6 master/universal keys, minimum, to Owner.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
 1. Provide mechanical attachment of all accessories. Use of adhesive or double-side tape is not acceptable.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 TOILET ACCESSORIES SCHEDULE, GENERAL

- A. General: The following products make reference to the designations indicated on the Toilet Accessories Schedule, Toilet Assemblies, and toilet room plans on the drawings; herein designated as "TA-x".

2.05 COMMERCIAL TOILET AND BATH ACCESSORIES

- A. Grab Bars (TA-A, B, & C): Stainless steel, smooth surface.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - 1) A&J Washroom Accessories, Inc.; UG2 Series.
 - 2) American Specialties, Inc.; 3700 Series.
 - 3) Bobrick Washroom Equipment, Inc.; B-5806 Series.
 - 4) Bradley Corporation; 832 Series.
- B. Toilet Paper Dispenser (TA-D): Roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, surface-mounted, stainless steel unit with pivot hinge, tumbler lock.
 1. Products:

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- a. American Specialties, Inc.; Model 20030.
 - b. Bobrick Washroom Equipment, Inc.; Model B-4288.
 - c. Bradley Corporation; Model 5402.
- C. Sanitary Napkin Disposal Unit (TA-E): Stainless steel, surface-mounted, self-closing door, with full-length stainless steel piano-type hinge, removable receptacle.
- 1. Products:
 - a. A&J Washroom Accessories, Inc.; Model U591.
 - b. American Specialties, Inc; Model 20852.
 - c. Bobrick Washroom Equipment, Inc.; Model B-270 Contura.
 - d. Bradley Corporation; Model 4781-11.
- D. Soap Dispenser (TA-F): Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
- 1. Minimum Capacity: 40 ounces.
 - 2. Products:
 - a. A&J Washroom Accessories, Inc.; Model U126.
 - b. American Specialties, Inc.; Model 0347.
 - c. Bobrick Washroom Equipment, Inc.; Model B-2111.
 - d. Bradley Corporation; Model 6562.
- E. Mirrors (TA-G): Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
- 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Size: As indicated on drawings.
 - 3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 - 4. Products:
 - a. A&J Washroom Accessories, Inc.; U700 Series.
 - b. American Specialties, Inc; 0600 A Series.
 - c. Bobrick Washroom Equipment, Inc.; Model B-290.
 - d. Bradley Corporation; Model 780.
- F. Corner Grab Bar Assembly (TA-H): Stainless steel, smooth surface.
- 1. Stainless-Steel Nominal Thickness: 0.05 inch.
 - 2. Finish: Satin.
 - 3. Mounting: Concealed with manufacturer's standard flanges and anchors.
 - 4. Outside Diameter: 1-1/4 inches unless otherwise indicated.
 - 5. Configuration: Single "L" shaped shower grab bar.
 - a. Length (Control Wall): 32 to 34 inches from wall to centerline of return.
 - b. Length (Back Wall): Nominal 18 inches from wall to centerline of return. Limit leg length so as not to interfere with folding shower seat.
 - 6. Products:
 - a. A&J Washroom Accessories, Inc.; Model UG20-G3016.
 - b. American Specialties, Inc.; Model 3774.
 - c. Bobrick Washroom Equipment, Inc.; Model B-6861 (1-1/2 inches OD).
- G. Folding Shower Seat (TA-J): Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless

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steel, L-shaped seat.

1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of manufacturer's standard color.
 2. Size: ADA Standards compliant.
 3. Products:
 - a. A&J Washroom Accessories, Inc.; Model U929.
 - b. American Specialties, Inc.; Model 8206.
 - c. Bobrick Washroom Equipment, Inc.; Model B-5181.
 - d. Bradley Corporation; Model 9569.
- H. Shower Curtain Rod (TA-L): Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.
1. Products:
 - a. A&J Washroom Accessories, Inc.; Model UX2-C.
 - b. American Specialties, Inc; Model 1204.
 - c. Bobrick Washroom Equipment, Inc.; Model B-6047.
 - d. Bradley Corporation; Model 9539.
 2. Shower Curtain: Provide shower curtain with each shower curtain rod.
 - a. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - b. Size: Provide curtain width 6 inches wider than shower opening dimension for 36 inch showers, and 12 inches wider than shower opening dimension for 48 inch and larger showers. Provide curtain height sized to 2 inches less than curtain rod mounting height.
 - c. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
 - d. Color: White.
 - e. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- I. Combination Towel Dispenser/Waste Receptacle (TA-R): Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
1. Waste receptacle liner: Provide with manufacturer's reusable, molded plastic liner accessory with stainless steel support strap. Bobrick "LinerMate" or equivalent.
 2. Towel dispenser capacity: 800 multi-fold; 600 C-fold.
 3. Waste receptacle capacity: 12 gallons.
 4. Products:
 - a. AJW Architectural Products; Model U650.
 - b. American Specialties, Inc; Model 0469.
 - c. Bobrick Washroom Equipment, Inc; Model B-3944.
 - d. Bradley Corp; Model 234.
- J. Robe Hook (TA-T): Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish. Provide one centered on interior face of door of all single-user toilet rooms and one adjacent to each shower, unless otherwise indicated on Drawings; verify final mounting locations with Architect in field.
1. Products (Double-Prong):
 - a. A&J Washroom Accessories, Inc.; Model UX112.
 - b. American Specialties, Inc.; Model 7345.

- c. Bobrick Washroom Equipment, Inc.; Model B-7672.
- d. Bradley Corporation; Model 9124.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 - 1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 - 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 - 3. Construction: 1/8 inch flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Microbial and Fungal Resistance: Comply with ASTM G21.
 - 4. Color: White.
 - 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
 - 6. Products:
 - a. Plumberex Specialty Products, Inc; Plumberex Trap Gear.
 - b. Truebro; IPS Corporation; Lav Guard 2.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder (TA-X): 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch diameter.
 - 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 - 4. Length: 36 inches.
 - 5. Products:
 - a. A&J Washroom Accessories, Inc.; Model UJ41B.
 - b. American Specialties, Inc; Model 1315-4.
 - c. Bobrick Washroom Equipment, Inc.; Model B-224 x 36.
 - d. Bradley Corporation; Model 9984.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.03 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide.
- B. NFPA 10 - Standard for Portable Fire Extinguishers.
- C. UL (DIR) - Online Certifications Directory.

1.02 SUBMITTALS

- A. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and trim and door panel styles.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.03 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.
- B. Coordinate rough opening sizes to ensure cabinet locations meet ADA mounting requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers and Cabinets:
 - 1. Activar Construction Products Group, Inc. - JL Industries.
 - 2. Amerex Corporation.
 - 3. Ansul, a Tyco Business.
 - 4. Babcock-Davis.
 - 5. Badger Fire Protection.
 - 6. Buckeye Fire Equipment Company.
 - 7. Fire-End & Croker Corporation.
 - 8. Kidde, a unit of United Technologies Corp.
 - 9. Modern Metal Products; Div of Technico.
 - 10. Larsen's Manufacturing Co.
 - 11. MOON American.
 - 12. Nystrom, Inc.
 - 13. Oval Brand Fire Products.
 - 14. Potter-Roemer.
 - 15. Pyro-Chem, a Tyco Business.
 - 16. Strike First Corporation of America.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 1. Class: 4-A: 60-B:C.
 2. Size: 10 pound.
 3. Finish: Baked polyester powder coat, color as selected.
 4. Temperature range: Minus 40 degrees F to 120 degrees F.
- C. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
 1. Class: K type.
 2. Size: 1.6 gallons.
 3. Temperature range: Minus 20 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Cabinet Construction: Non-fire rated.
 1. Formed cold-rolled steel sheet; minimum 0.036 inch thick base metal.
 2. Available Products: One of the following, or comparable product by manufacturer from list above:
 - a. J.L. Industries/Activar; Ambassador 1017.
 - b. Larsen's Manufacturing Co.; Model 2409-6R.
 - c. Potter-Roemer; Model 1724.
- B. Cabinet Configuration: Semi-recessed type.
 1. Size to accommodate extinguisher(s) and accessories indicated.
 2. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
 3. Trim Type: One piece trim and door frame, returned to wall surface. Rolled edge trim; 2-1/2- to 3-inch depth as standard with manufacturer.
 4. Door Glazing Style: Vertical duo, configuration as standard with manufacturer.
- C. Door: Minimum 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with continuous piano hinge.
- D. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Operating Hardware: Manufacturer's standard for cabinet type; continuous door hinge allowing 180 degree opening, with ADA-compliant door latch either surface mounted or flush inset into door panel, with cam or friction latch operation.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated or baked-enamel finish.
 - B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced lettering in accordance with authorities having jurisdiction (AHJ).
 1. Apply vertically to door of fire extinguisher cabinets, and apply to wall surface at bracket mounted extinguishers.
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2.05 EMERGENCY KEY ACCESS BOX

- A. Commercial Door Key Access Box: Provide fire department emergency key access box manufactured by The Knox Company; as required by local Fire Marshal. Provide Knox Box recessed mount 3200 Series, nominal 4 inches by 5 inches by 3-1/4 inches deep, with tamper switch and recessed mounting kit. Provide manufacturer's standard polyester powder coat finish in black color. No substitutions will be considered. Coordinate recessed installation with substrate construction, electrical connections as required for proper operation, and with requirements of local Fire Marshal. Contact Knox Company: www.knoxbox.com

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, no greater than 48 inches from finished floor to top of handle.
- C. Install mounting brackets at 44 inches above finish floor.
- D. Secure rigidly in place.
- E. Place extinguishers and accessories in cabinets and on wall brackets.
- F. Adjust cabinet doors after installation to ensure smooth operation.

3.03 PROTECTION AND CLEANING

- A. Protect fire extinguishers, fire extinguisher cabinets, and accessories from damage until Substantial Completion.
- B. Provide touchup to damaged finishes; replace items that cannot be satisfactorily repaired or refinished.

END OF SECTION 104400

**SECTION 105113
METAL LOCKERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with Section 033000 - Cast-in-Place Concrete to provide 4-inch high concrete bases with embedded anchors or grounds as required for locker attachment.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- B. Shop Drawings: Indicate locker plan layout, numbering plan.
- C. Samples: Submit manufacturer's color charts illustrating full range of available colors.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2 year manufacturer warranty for materials and workmanship. Complete forms in Owner's name and register with manufacturer.
 - 1. Warranty shall cover failures including material and finish failure and faulty operation of latches, hinges, or other hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lockers:
 - 1. Art Metal Products; Standard KD.
 - 2. List Industries, Inc; Classic Line of Superior KD.
 - 3. Lyon Workspace Products; Standard Lockers.
 - 4. Penco Products, Inc; Vanguard.
 - 5. Republic Storage Systems Co; Standard.

2.02 LOCKER APPLICATIONS

- A. Wardrobe Lockers: Metal lockers, free-standing with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Configuration: Two tier.

5. Fittings (Two-Tier): Provide one double-prong ceiling hook and two single-prong wall hooks, one on each side wall.
6. Ventilation: Louvers at top and bottom of door panel.
7. Locking: Padlock hasps, for padlocks provided by Owner.
8. Provide sloped top.
9. Color: To be selected from manufacturer's full range by Architect.

2.03 METAL LOCKERS

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
 1. Quantity: Provide not less than one ADA-compliant locker for every 20 total; for each locker type (single-tier and two-tier). Locate ADA lockers at end of locker run with clear access space.
 2. Locate bottom shelf no lower than 15 inches above floor.
 3. Locate hooks, coat rods, and shelves no higher than 48 inches above floor.
 4. Provide ADA-compliant recessed handle and latch, no higher than 48 inches above floor.
 5. Provide 3" x 3" aluminum plate logo with the international symbol of accessibility on each ADA-compliant locker.
- B. Lockers: Factory assembled, made of formed sheet steel, ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
 1. Where ends or sides are exposed, provide flush panel closures.
 2. Provide filler strips where indicated, securely attached to lockers.
 3. Color: To be selected by Architect . Manufacturer's standard neutral color is acceptable for locker interiors.
- C. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
 1. Tops, Sides, and Shelves: 16 gauge, 0.0598 inch minimum.
 2. Backs: 18 gauge, 0.0478 inch minimum.
 3. Reinforced Bottoms: 16 gauge, 0.0598 inch minimum with channel edge; welded to frame panels, with manufacturer's standard stiffeners.
- D. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
 1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
 2. Form recess for operating handle and locking device.
- E. Latches and Door Handles: Manufacturer's standard.
- F. Hinges: Heavy duty, 5- or 7-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
- G. Sloped Top: 18 gauge, 0.0478 inch minimum, with closed ends.
- H. Filler Panels, End Closures and Trim: 18 gauge, 0.0478 inch, minimum.
- I. Number Plates: Provide oval shaped aluminum plates. Form numbers of block font style with ADA designation, in contrasting color.
- J. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with padlock hasps, for padlocks provided by Owner.

2.04 LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
-

1. Standard Benchtop Dimensions: 9-1/2 inches deep by 1-1/4 inches thick; lengths indicated on Drawings. Where not indicated, provide 8 foot long benches.
2. Height: 17-1/2 inches to top of bench; at all benches.
3. Accessibility: Where accessible benches are indicated, comply with ICC A117.1 and ADA Standards.
 - a. Accessible Bench Dimensions: 42 inches wide by 20 inches deep, minimum.
 - b. Where accessible bench is not indicated to be installed against a wall, provide unit with a backrest extending at minimum 18 inches above the bench top. Each backrest shall be mounted to bench with at least two mounting brackets.
4. Pedestals: Tubular steel, with mounting flanges welded to each end; fixed to floor.
 - a. Pedestal Finish: Powder coat; match locker exterior finish color.
 - b. Fasteners: Provide with manufacturer's standard fasteners for securing benchtop to pedestals, and provide concrete expansion/wedge anchors for anchorage to floor slab. Provide all anchors with heads color-matched to pedestals.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify bases and embedded anchors and grounds are properly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Bolt or rivet adjoining locker units together to provide rigid installation.
- E. Install end panels, filler panels, and sloped tops.
- F. Install fittings if not factory installed.
- G. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 105113

**SECTION 105113.13
METAL EVIDENCE LOCKERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. 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.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate blocking, furring, wall reinforcing, embedded anchors, and other associated work to confirm adequate support is provided for attachment of lockers.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- B. Shop Drawings: Indicate locker plan layout, numbering plan.
- C. Selection Samples: Submit manufacturer's color charts illustrating full range of available colors.
- D. Installer's qualification statement.
- E. Maintenance Data: Provide manufacturer's data for operable locker doors; including adjustment, repair, and replacement of locker doors and latch and lock assemblies.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Furnish 20 additional complete lock assemblies for Owner's maintenance use.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified; authorized representative of manufacturer for installation and maintenance of the units required for this Project.
- B. Source Limitations: Provide all evidence lockers from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage with protective coverings. Do not remove protective coverings until ready to install.
- B. Store evidence lockers in a dry, enclosed space. Do not install until installation spaces are enclosed, interior finishes in installation spaces are completed, and spaces are conditioned at occupancy conditions.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer Warranty: Provide 4 year manufacturer warranty for materials and workmanship on welded evidence lockers. Complete forms in Owner's name and register with manufacturer.
 - 1. Warranty shall cover failures including material and finish failure and faulty operation of latches, hinges, or other hardware.
 - 2. Warranty shall cover that refrigeration units shall be free from defects in materials and workmanship for one (1) year from the date of the customer's written acceptance of

installation. During the 1-year warranty period, all parts are included at no cost for 1 years. Labor is included at no cost during the first year of the 1-year warranty period. After the first year of the 1-year warranty, all labor will be charged at the then-current rate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Evidence Lockers:
 - 1. Tiffin Metal Products; Evidence Lockers (Basis-of-Design).
 - 2. Fasco Security Products; Police Evidence Lockers.
 - 3. Spacesaver Corporation; Secure Evidence Lockers.
 - 4. Southwest Solutions Group; Police Evidence Lockers.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Evidence Lockers: Pass-through metal evidence lockers, free-standing with matching closed base.
 - 1. Width: 36 inches.
 - 2. Depth: 24 inches.
 - 3. Height: 82 inch total nominal height (78 inch locker height and 4 inch integral base).
 - 4. Configurations: Multiple configurations shall be required. Refer to elevations on drawings for layout and size of each compartment with unit. Final desired configurations shall be confirmed with Owner during shop drawing/submittal phase prior to furnishing.
 - a. Steele Solutions/Tiffin 06AC (Quantity 1): 36 inch wide unit, 6 total compartments.
 - b. Steele Solutions/Tiffin **11AA** (Quantity 1): 36 inch wide unit, 11 total compartments.
 - c. Steele Solutions/Tiffin **14AB_R** (Quantity 1): 36 inch wide unit, 15 total compartments, including 1 refrigerated compartment.
 - 5. Locking: Digital keypad type.

2.03 METAL EVIDENCE LOCKERS

- A. Lockers: Factory assembled, made of cold-rolled formed sheet steel, ASTM A1008/A1008M, stretcher leveled; metal edges finished smooth without burrs; baked enamel finished inside and out.
 - 1. Where ends or sides are exposed, provide flush panel closures.
 - 2. Provide filler strips where indicated, securely attached to lockers.
 - 3. Color: To be selected by Architect. Manufacturer's standard neutral color is acceptable for locker interiors.
- B. Locker Body: Formed and flanged; with steel stiffener ribs; all-welded.
 - 1. Tops, Sides, and Shelves: 16 gauge, 0.0598 inch minimum.
 - 2. Backs: 18 gauge, 0.0478 inch minimum.
 - 3. Reinforced Bottoms: 16 gauge, 0.0598 inch minimum with channel edge; welded to frame panels, with manufacturer's standard stiffeners.
- C. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1. Door Frame: 16 gauge, 0.0598 inch, minimum.
- D. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.

1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
- E. Hinges: Heavy duty, 5- or 7-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
- F. Filler Panels, End Closures and Trim: 18 gauge, 0.0478 inch, minimum.
- G. Number Plates: Provide oval shaped aluminum plates. Form numbers of block font style, in contrasting color.
- H. Locks: Digital pass back keypad type for 4-digit code.
- I. Half Height Refrigerator: 37.44 inches high by 36 inches wide by 24 inches deep pass-thru compartment.
 1. Construction: Stainless steel interior and exterior with 100% CFC free polyurethane foam insulation.
 2. Features:
 - a. Chamber cooling provided by cold (forced) air circulation.
 - b. Magnetic seals on outer doors.
 - c. Digital controls with all settings preset to maintain 38 to 42 degrees Fahrenheit.
 - d. Audible alarm.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors and grounds are properly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- E. Bolt or rivet adjoining locker units together to provide rigid installation.
- F. Install end panels and filler panels.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 105113.13

**SECTION 105129
PHENOLIC LOCKERS**

PART 2 PRODUCTS

1.01 MANUFACTURERS

- A. Phenolic Lockers:
 - 1. ASI Storage Solutions.
 - 2. Columbia Lockers, a division of PSiSC.
 - 3. List Industries, Inc.
 - 4. Summit Lockers, Inc.

1.02 LOCKER APPLICATIONS

- A. Wardrobe Lockers: Phenolic lockers, wall mounted with matching closed base.
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Width: 12 inches.
 - 3. Depth: 12 inches.
 - 4. Depth: 12 inches.
 - 5. Height: 72 inches.
 - 6. Locker Configuration: Z-tier (2 lockers each with a short and long compartment).
 - 7. Fittings: Size and configuration as indicated on drawings.
 - a. Hooks: One double prong.
 - 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - 9. Provide sloped top.

1.03 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 - 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 - 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
 - 4. Door Color: As selected by Architect.
 - 5. Body Color: Manufacturer's standard white or light color.
 - 6. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
 - 1. Doors: 1/2 inch minimum thickness.
 - 2. Locker Body: One of the following combinations:
 - a. Tops, bottoms, and shelves 3/8 inch; sides and backs 5/16 inch; minimum.
 - b. Tops, bottoms, and shelves 1/2 inch; sides 3/8 inch; backs 1/4 inch; minimum.
 - 3. End Panels and Filler Panels: 1/2 inch minimum thickness.
 - 4. Sloped Tops: 1/2 inch minimum thickness.
 - 5. Toe Kick Plates: 1/2 inch minimum thickness.

- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
 - 1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.
- D. Hinges: Stainless steel, black powder coat finish; minimum of 180 degree opening; either exposed barrel 5-knuckle hinge attached to back of door and inside of body with tamperproof screws, or concealed cabinet style hinge attached with tamperproof screws.
- E. Coat Hooks: Stainless steel or reinforced nylon; attached with tamperproof screws.
- F. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- G. Locks: Locker manufacturer's standard type indicated above.
- H. Lock Strike: Stainless steel, or black high impact ABS plastic strike plate attached to locker body with throughbolts.
- I. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with padlock hasps, for padlocks provided by Owner.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels, filler panels, and sloped tops.
- F. Install accessories.
- G. Replace components that do not operate smoothly.

2.02 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 105129

**SECTION 105613
METAL STORAGE SHELVING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI MH28.1 - Multi-Level Shelving Systems Utilizing Industrial Grade Steel Shelving.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Rated uniform shelf loads.
 - 2. Details of shelving assemblies, including reinforcement.
 - 3. Accessories.
- B. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate methods of achieving specified anchoring requirements.
- C. Selection Samples: For each finish product specified, provide color chart representing manufacturer's full range of available colors and finishes.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged units.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Four Post Shelving:
 - 1. Hallowell
 - 2. List Industries, Inc
 - 3. Montel
 - 4. Penco Products, Inc
 - 5. SpaceSaver Corporation.
 - 6. Tenssco Storage
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 SHELVING - GENERAL

- A. General: All shelving shall comply with ANSI MH28.1.
- B. See drawings for layout and sizes.
- C. Seismic Design: Design for Seismic Zone, in accordance with ASCE 7, Section 9.
- D. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
 - 1. Provide hardware of type recommended by manufacturer for substrate.
 - 2. Wall Anchorage: Provide manufacturer's standard "Z" shape wall mount system, fabricated of two L-angles back to back, and fastened together with two nuts and bolts. Anchorage of post directly to wall is not acceptable. Prior to wall attachment, install foot

plates at base of all posts and shim or adjust to achieve level and plumb installation.

2.03 FOUR POST SHELVING

- A. Four Post Shelving: Steel post-and-shelf type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
 - 1. Unit Sizes:
 - 2. Shelf Capacity: 800 lb for 36 inch wide units, 600 lb for 42 inch wide units, and 500 lb for 48 inch wide units.
 - 3. Adjustability of Shelving: Continuous along length of post (1 inch centers).
 - 4. Shelves per Unit: 6 shelves total; top, bottom, and 4 intermediate.
 - 5. Unit Height: 84 inches, nominal. (Penco basis-of-design is 87 inches high)
 - 6. Finish: Baked enamel, medium gloss.
 - 7. Color: To be selected by Architect from manufacturer's full range.
- B. Posts: Formed sheet members; perforations exposed on face of members are not acceptable.
 - 1. Metal Thickness: Manufacturer's standard for shelf quantity and loading requirements.
 - 2. Connecting Hardware: Manufacturer's standard.
 - 3. Post Bases: Flat steel foot plate, with manufacturer's recommended adjustable leveling device; pre-drilled for floor anchors.
- C. Bracing: Formed sheet members.
 - 1. Back Sway Bracing: Strap type; at back of each unit.
 - 2. Side Sway Bracing: Strap type; at each side of each unit.
 - 3. Strap Sway Bracing: Two straps crossed diagonally, of manufacturer's standard steel sheet thickness; welded, riveted, or bolted to uprights.
- D. Shelves: Formed sheet, finished on all surfaces .
 - 1. Metal Thickness: 18 gauge, 0.0478 inch.
 - 2. Shelf Edge Profile: Extending 3/4 inch, maximum, below top surface of shelf.
 - 3. Shelf Connection to Posts: Manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor and reinforce as specified, and as recommended by manufacturer.
 - 1. Anchor to floor with floor anchors, secured through pre-drilled floor plates.

2. Shim and adjust floor plates prior to installation of wall anchors.
3. Anchor to wall with manufacturer's standard "Z" shape wall mount system.
- C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.04 CLEANING

- A. Clean shelving and surrounding area after installation.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 105613

**SECTION 105626
MOBILE STORAGE SHELVING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. ISO 9001 - Quality Management Systems — Requirements.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. System components.
 - 2. Accessories.
 - 3. Substrate preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
- B. Shop Drawings: Indicate location, type, and layout of mobile storage shelving system, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate location and configuration of rails.
 - 2. Indicate method of installation and configuration for shelving mounted on carriages.
 - 3. Provide location and details of anchorage devices to be embedded in or fastened to the structure.
- C. Selection Samples: For each finish product specified, provide color chips representing manufacturer's full range of available colors and finishes.
- D. Manufacturer's Qualification Statement.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, ISO 9001 certified for quality control standards for design, production, and installation of complete high density storage system assemblies.
- B. Installer Qualifications: Company specializing in performing the work of this section; certified or authorized by manufacturer for installation of specified products.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged components.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade, in an enclosed, weatherproof location.

1.05 FIELD CONDITIONS

- A. Field Measurements: Verify field measurements for locations of mobile storage shelving before preparation of shop drawings and before fabrication to ensure proper dimensions, clearances, and installation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.01 MOBILE STORAGE SHELVING SYSTEMS - GENERAL

- A. System Description: High-density movable shelving system consisting of shelving units mounted on rail-guided wheeled carriages.
 - 1. Carriage Operation: Mechanically assisted.
 - 2. Carriage Capacity: 1000 pounds per lineal foot.
 - 3. Rail Mounting: Recessed in concrete slab with finished floor flush with top of rails.
 - 4. System Layout: Refer to Drawings, and to Shelving Size Schedule below. Size carriages and system to manufacturer's standards to accommodate shelving units required.
 - 5. Overall System Height: Nominal 84 inches.
- B. Seismic Design: Design for Seismic Zone 3, in accordance with ASCE 7 Section 9.
- C. Accessibility Requirements: Comply with ADA Standards.
- D. Components:
 - 1. Carriages: Rectangular steel frames of type and size required for selected system.
 - a. Provide one fixed end carriage and the remainder movable carriages at each system. Fixed end carriage shall be anchored to rails. Exposed back panel of fixed carriage shall match construction and finish of other exposed panels.
 - b. Carriage frames shall be steel and shall be welded or bolted. Galvanized components and riveted construction are unacceptable.
 - c. Finish: Powder coat paint; color to match shelving.
 - 2. Wheels: Cold rolled steel; dual flanged.
 - 3. Rails: Cold rolled steel; type and size to carry loads imposed by system.
 - 4. Subrails: Aluminum; use as required for recessed rails.
 - 5. Anti-Tip Device: Provide manufacturer's standard rail device to prevent tipping of system.
 - 6. Shelving Units: Provide manufacturer's standard four-post steel shelving that integrally interlocks into carriage. Provide shelving with 6 levels (bottom shelf and 5 intermediate shelves) and dividers every 12 inches (provide one divider at 24- and 30-inch wide shelving units, and two dividers at 36-inch wide shelving units).
 - a. Shelving Size Schedule:
 - 1) Shelving at Fixed Carriage:
 - (a) 36 inch wide by 15 inch deep (single-sided) shelving.
 - 2) Shelving at Movable Carriages:
 - (a) 36 inch wide by 30 inch deep (two-sided) shelving.
 - 7. Floor Panels: Underlayment grade plywood, 3/4 inch thick.
 - 8. Ramps: Steel; 4.76 degrees maximum slope (do not exceed 1:12 for accessibility compliance).
 - a. Do not exceed 1/8 inch vertical lip where ramps transition to adjacent finish floor.
 - 9. Floor Covering: Coordinate with flooring installer to provide carpet tile to match adjacent flooring in the space. Coordinate to ensure flooring installation does not affect operation of system.

10. Face Panels: High pressure laminate over particleboard core; full height and width of shelving.
 - a. Color: To be selected from shelving manufacturer's full range of available options
 11. Grout: Non-shrink hydraulic type cement.
- E. Accessories:
1. Anchors and Leveling Screws: Types and sizes recommended by manufacturer for specified rail mounting and floor system.
 2. Bumpers: Manufacturer's standard rubber stops.
 3. Label Holders: Manufacturer's standard type, attached to face panel at end of each shelving unit.

2.02 MECHANICALLY ASSISTED MOBILE STORAGE SHELVING SYSTEMS

- A. Basis of Design: Spacesaver; Mechanical Assist High Density Mobile Storage System.
- B. Other Acceptable Manufacturers:
1. Borroughs Corporation; Aisle-Saver; Synergy Series.
 2. Montel; Mobilex Mechanical Assist Storage.
 3. Substitutions: See Section 016000 - Product Requirements.
- C. Drive System: Provide uniform movement of the carriage without drifting or jerking.
1. Chain and sprocket system with full length torque resistant steel shaft.
 2. Provide two wheels per rail for each carriage, direct-driven on one side.
- D. Control: Three-spoke operating handle with manual locking latch.
1. Minimum Gear Ratio: 1 lbf to move a load of 6000 lbs.
- E. Safety System: Mechanical safety brake at toe level the full length of the carriage. Light pressure of 1.5 lbf on aluminum bar activates safety mechanism to stop carriage movement.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that substrate is in proper condition to install rails and flooring system per manufacturer's requirements.
1. Do not begin installation until concrete floor slabs are fully cured and prepared, finishes in the space are complete, and the space is conditioned at occupancy levels.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. General: Install system components and accessories in accordance with manufacturer's printed instructions.
- B. Position system components level and plumb within manufacturer's specified tolerances.
- C. Anchor rails directly to concrete subfloor.
- D. For recessed rail installation, grout rails the full length of the system.
- E. Maintain a minimum of 1/4 inch of grout between the high points of concrete subfloor and bottom of rails.
- F. Extend rails under stationary shelving units.

- G. Position carriages ensuring wheels align properly on rails. Fasten multiple carriages together forming a single movable base.
- H. Install shelving with shelf surfaces level and vertical supports plumb; fasten to carriage supports with vibration-proof fasteners.

3.03 ADJUSTING

- A. Adjust mobile storage shelving components and accessories to provide for smooth operation of system.

3.04 CLEANING

- A. Clean shelving and surrounding area after installation.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Location: At project site.

3.06 PROTECTION

- A. Protect installed system from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 105626

**SECTION 107300
PROTECTIVE COVERS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- E. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- F. AWS D1.2/D1.2M - Structural Welding Code - Aluminum.

1.02 SUBMITTALS

- A. Metal Product Data: Product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, footings, anchorage, size and type of fasteners, accessories and locations.
 - 1. Shop drawings shall be project specific; manufacturer's standard details are not acceptable.
 - 2. For protective covers indicated to attach to the building, include detail showing project-specific wall attachment detail that will transfer structural loads to the primary structural element of the exterior wall.
- C. Selection Samples: Manufacturer's color charts for metal components.
- D. Verification Samples: Manufacturer's standard size physical samples, representing actual material and finish of exposed metal, for each color selected by Architect.
- E. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
- F. Designer's qualification statement.
- G. Specimen warranty.

1.03 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide standard 1-year warranty covering all material deterioration, structural failure, and installation defect.

- C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of factory-applied finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design (Building Mounted): Mapes Architectural Products; Super Lumideck - Hanger Rod.
- B. Acceptable Comparable Manufacturers:
 - 1. Architectural Fabrication, Inc.
 - 2. Dittmer Architectural Aluminum.
 - 3. Mitchell Metals.
 - 4. Perfection Architectural Systems, Inc.
 - 5. Superior Mason Products, LLC.
 - 6. Tennessee Valley Metals.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 PROTECTIVE COVERS - GENERAL

- A. Design Criteria: Design and fabricate to resist gravity, wind, snow, ponding water, weather exposure, seismic, and other structural loads without failure, damage, or permanent deflection in accordance with ASCE 7, applicable building code, and as indicated on Drawings.
 - 1. Structural Design:
 - a. Building-Mounted: Provide engineered wall anchorage system capable of transferring structural loads to the structural CMU wythe or structural cold-formed steel framing (CFSF-S) of the exterior wall assembly. Do not support protective covers directly from brick veneer or other non-structural exterior claddings.
 - 2. Thermal Movement: Design protective covers to accommodate thermal movement caused by ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- B. Configuration: Column layout, dimensions, clearances, and design as indicated on drawings.
 - 1. Drainage Concept (Building-Mounted): Water collected in decking shall run to rear of protective cover into aluminum fascia/channel. Provide 2-inch diameter drain hole at one end of protective cover, with 3-inch by 3-inch downspout fabricated of smooth extruded aluminum. Downspout shall be fastened to wall with straps at minimum 60 inch on center. Downspouts shall drain on grade with splash block or into underground drainage, as indicated. Downspout and wall straps shall be finished to match protective cover.
- C. Provide a complete system ready for erection at project site.
- D. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.03 PROTECTIVE COVERS - ASSEMBLY

- A. Description: Flat top metal framework with metal covering supported by metal columns or hanger-rod assembly, as indicated.
- B. Framework: Aluminum.
- C. Covering Materials:
 - 1. Manufacturer's standard interlocking extruded aluminum decking modules.

2.04 COMPONENTS

- A. Components for Building-Mounted Protective Covers:
 - 1. Beams: Extruded aluminum.
 - a. Style: I-shaped beams; 3-1/4" x 3-1/4" x 1/4" nominal.
 - 2. Extruded Decking: Self-flashing, interlocking sections, minimum 0.078-inch thick.
 - a. Deck Profile: Manufacturer's standard deck section for corrugated soffit profile; size deck depth for depth of protective cover as indicated.
 - 3. Fascia: Extruded aluminum; height per manufacturer's standard profile; minimum 0.125-inch thickness.
 - 4. Hanger Rod Assembly: Manufacturer's standard 1-inch diameter hanger rod assembly, fabricated of schedule 40 galvanized steel. Provide aluminum clip angle bolted to aluminum I-beams for attachment of hanger rod assembly to canopy, with neoprene washers or other material standard to manufacturer for separation of dissimilar metals.
 - a. Wall Attachment: Provide threaded rod anchors, extending fully through exterior wall. Provide integral eyebolt, "U" bracket, or manufacturer's standard clevis assembly at rod attachment anchors for hanger rod attachment. At all through anchors, provide galvanized steel compression sleeves, sized to wall cavity and cladding depth, and additional construction as needed to prevent transferring structural loads onto veneer/cladding. All loads shall transfer to structural "backup" wall.
 - 1) The structural system above is per the Basis-of-Design product indicated. Manufacturer may submit an alternate pre-engineered structural system, provided the system complies with other requirements of this section and is capable of supporting loads from the primary wall structure.
- B. Exposed Framing Fasteners: Flush countersunk stainless steel screws or bolts; consistent with design of system and acceptable to manufacturer.
 - 1. Decking Fasteners: Stainless steel with neoprene washers.
 - 2. Finish exposed fasteners to match metal framing.
- C. Flashings: Metal and finish matching system framing components, with thickness as recommended by manufacturer for conditions encountered.
- D. Reinforcement Materials and Bracing: Where light fixtures, dimensional letter signage, or other items are indicated to be mounted to the protective cover, provide additional reinforcing or bracing elements to ensure a secure attachment to the protective cover without failure of decking or structural elements. Coordinate with submitted manufacturer(s) of items to be mounted to protective cover for loading requirements and attachment methods.

2.05 MATERIALS

- A. Aluminum:
 - 1. Aluminum Extrusions: Alloy and temper 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B221 (ASTM B221M), with minimum thickness 1/8 inch for structural members and 1/16 inch for nonstructural members.
- B. Concrete for Footings: Refer to Division 3 Section "Cast-in-Place Concrete."
- C. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.
- D. Bituminous Coating: ASTM D 1187 asphaltic coating or comparable protective coating to prevent corrosion between materials. Building felt is not acceptable.

2.06 FABRICATION - METAL COMPONENTS

- A. Fit and shop assemble components in largest practical sizes, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Provide notches, cut outs, and internal deflectors in members as noted to act as internal water drainage system.
- D. Weld aluminum members in accordance with AWS D1.2/D1.2M.
- E. Exposed Fastenings: Unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of framing. Fabricate anchors and related components of same material and finish as framing, except where specifically noted otherwise.
- G. 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.
- H. Accurately form components to suit each other and to building structure.

2.07 FINISHES

- A. High Performance Organic Coatings: AAMA 2604, multiple coats, thermally cured fluoropolymer system.
- B. Finish Color: To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that foundation, electrical utilities, and placed anchors are in correct position.
- C. Verify that bearing surfaces are ready to receive this work.
- D. Do not proceed with installation until conditions are satisfactory.

3.02 INSTALLATION - FRAMING

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.
- C. Building Mounted Canopies: Provide threaded anchor assemblies required for connecting framing to structure. Anchor framing to primary structural wall elements. Where primary structure of exterior wall is cold-formed steel framing (CFSF-S metal studs), provide additional fire-retardant treated wood blocking between metal stud members to accommodate hanger rod spacing.
- D. Protective Coating: Provide a protective coating to separate aluminum surfaces from masonry, concrete or cementitious materials, and dissimilar metals.

3.03 INSTALLATION - METAL COVERING

- A. Install in accordance with manufacturer's instructions.
- B. Fasten metal decking to metal support members, aligned level and plumb.
- C. Install fascia panels, trim, and flashing.
- D. Separate dissimilar metals using concealed bituminous paint.

- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.04 TOLERANCES

- A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet, or 3/8 inch total in overall dimension.
- B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inches.

3.05 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean all exposed surfaces after installation.

3.06 PROTECTION

- A. Touch-up, repair, or replace damaged components before Date of Substantial Completion.
- B. Protect protective covers after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION 107300

**SECTION 107500
FLAGPOLES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
- D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles.

1.02 SUBMITTALS

- A. Product Data: Provide data on pole, accessories, and configurations.
- B. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
- C. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole assemblies, including foundations, under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flagpoles:
 - 1. American Flagpole & Flag Co.
 - 2. Baartol Co., Inc.
 - 3. Concord American Flagpole.
 - 4. Eagle Mountain Flag and Flagpole.
 - 5. Eder Flag Manufacturing Co., Inc.
 - 6. Morgan-Francis Flagpoles & Accessories
 - 7. Pole-Tech Co, Inc.
 - 8. Substitutions: See Section 016000 - Product Requirements.

2.02 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001.
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.

3. Mounting: Ground mounted type.
 4. Nominal Height: Provide two flagpoles, one 20 foot tall and one 25 foot tall; measured from nominal ground elevation.
 5. Halyard: External type.
 - a. Provide one halyard at each flagpole.
 - b. Snap Hooks: Provide two snap hooks per halyard; fabricated of brass.
- B. Performance Requirements:
1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

- A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.04 ACCESSORIES

- A. Finial Ball: Aluminum, 6 inch diameter.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Cleats: 9 inch size, aluminum with galvanized steel fastenings, one per halyard.
- D. Halyard: 5/16 inch diameter nylon, braided, white.
- E. Lights: Provide down lighting, mounted to top of each flagpole in lieu of finial ball. Lights shall be LED a maximum of 20 watts each, a minimum of 700 lumens, and shall be complete with all internal wiring. Lighting control shall be mounted at 8'-0" above ground level. Basis-of-Design Product: "Downlight Dome" by Eagle Mountain Flag and Flagpole.

2.05 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gauge, 0.0598 inch steel, galvanized, depth as indicated on Drawings.

2.06 FINISHING

- A. Metal Surfaces in Contact With Concrete: Protect with bituminous/asphaltic coating.
- B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
- C. Aluminum: Mechanical finish; medium satin directionally textured (AA-M32).
- D. Finial: Spun finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

- A. Install flagpole and fittings in accordance with manufacturer's instructions.
- B. Electrically ground flagpole installation with ground spike and plate.

- C. Fill base around foundation tube sleeve with concrete specified in Section 033000.
- D. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.
- E. Fill foundation tube sleeve with sand and compact.
- F. Seal around top of foundation tube sleeve with two inches of elastomeric sealant.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

- A. Adjust operating devices so that halyard functions smoothly.

END OF SECTION 107500

SECTION 111900 - DETENTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Detention Equipment Contractor (DEC):

1. Provide the Detention Equipment indicated on the Drawings, in schedules, and as specified in this section.
2. Types of Detention Equipment:
 - a. Detention Mirror, Single & Double
 - b. Detention 4-Man Table, standard & accessible
 - c. Detention Stool, floor-mounted
 - d. Detention Swing Stool, wall-mounted
 - e. Detention Floor-mounted Bench
 - f. Transaction Drawer / Package Pass
 - g. Hopper Pass
 - h. Tilt Drawer Pistol Locker, Surface Mount
 - i. Recessed Toilet Paper Roll Holder
 - j. Stainless Steel Counters and Work Shelves
 - k. Detention Grab Bars, Anti-Ligature
 - l. Detention Shower Grab Bars, Anti-Ligature
 - m. Wall Embed Plates for detention grab bars
 - n. Detention Folding Shower Seat
 - o. Safety Shower/Clothes Hook
 - p. Security Steel Bar Grillage
 - q. Detention Shower Curtain & Track
 - r. Key Cabinet is specified in Section 111960
3. Refer to Division 13 Section "[Manufactured Steel Detention Cells](#)" for detention equipment provided in and/or as part of the construction of these systems, including, but not limited to, wall-mounted bunks, grab bars, and toilet paper holders.
4. Refer Division 22 Section "[Security Plumbing Fixtures](#)" for detention equipment provided in and/or as part of the construction of cabinet showers, including, but not limited to, wall-mounted grab bars and stainless steel shower seats.
5. Furnish to the General Contractor, for installation, all embedded anchors for Detention Equipment.
6. Coordinate installation of the embedded items and the actual detention equipment with the appropriate Contractors.
7. Coordinate with the Security Control System Contractor (SCSC), as described in Section 285000.

B. General Contractor:

1. Install embedded anchors for Detention Equipment in accordance with manufacturer's and detention equipment subcontractor's shop drawings.

2. Coordinate installation of embedded items with the DEC.

1.3 QUALITY ASSURANCE

- A. The Detention Equipment Contractor (DEC) shall provide all detention equipment, shop drawing submittals, testing reports, and samples as described in Specification Sections 111900, 111910, 111950, and 111960. The DEC shall coordinate the work of all these specification sections with his various equipment manufacturers, fabricators, installers, and, also, with work by others. Questions on the Detention Work shall be directed to the DEC before being directed to the General Contractor, Architect, or Owner.
- B. Available Detention Equipment Contractors (DEC):
 1. Cornerstone Detention
Decatur, AL 35601
 2. Montgomery Technology Systems
Greenville, AL 36037 & San Antonio,
TX 78219
 3. Pauly Jail Building Company
Noblesville, IN 46062
 4. CML Security, LLC
Broomfield, CO 80023
 5. Noah Detention Construction, LLC
Niceville, Florida 32578

1.4 DETENTION EQUIPMENT CONTRACTOR'S (DEC) QUALIFICATIONS

- A. It is critical that the Detention Equipment meets the requirements of the Contract Documents and that the equipment and/or systems be properly installed and functioning correctly by the Time of Completion specified.
- B. A specialty DEC is required for this project. Refer to Sections 111900, 111910, 111950, and 111960 for scope of work.
- C. It is not, however, the intent of the Owner or Architect to unfairly restrict competition. Other equally competent DEC's who meet the 'qualification criteria' specified herein shall be added to the list of 'Available Detention Equipment Contractors (DEC)' by addendum.
- D. All competent non-listed DEC's may request to be listed by submitting the data requested in the Qualification Criteria, a minimum of fifteen (15) days prior to bid receipt date.
- E. All other competent DEC's will be listed in an addendum. Verbal approval will not satisfy this requirement. Grounds for disqualification shall exist if, in the opinion of the Architect, the information submitted is inaccurate or does not comply with the requirements of this specification. There will be no exceptions.
- F. QUALIFICATION CRITERIA FOR THE DEC: It is critical that the Detention Equipment meets the requirements of the Contract Documents and that the equipment and systems be properly installed and functioning correctly by the Time for Completion specified for the project. Therefore, the DEC must meet the following qualification criteria:
 1. Perform at least 50 percent of the Work (on-site installation) with its employees. Submit payroll record of executing project installation labor with a minimum of 50 percent of labor performed by direct employees of the DEC Company.
 2. Provide a narrative of the history of the company from inception; including history of ownership, partnership, incorporation and/or other organizational information. Include information on the growth of the firm over time to include number of employees,

- relocation(s) of the firm, major production equipment purchases and replacements. Use only the current corporate/business entity, intending on bidding and performing the work.
3. Provide a statement that the firm has been in business under its current name for minimum of ten (10) continuous years.
 4. Provide a list of all employees in supervisory positions stating their area of responsibility and their years of experience in that position.
 - a. Number of years as a full-time employee of the DEC
 - b. Number of years of jail experience
 - c. Completed training program for iron workers (if involved in equipment installation)
 5. Submit a complete list of all projects completed under the DEC's current name. Specifically highlighting projects completed in NC, SC and VA, including:
 - a. Project Name, Owner, Contact Name, Address, and Phone Number
 - b. Architect/Engineer of Record Name, Address, and Phone Number
 - c. General Contractor or Construction Manager Name, Address, and Phone Number
 - d. Total Amount of the DEC's Contract and Completion Date
 6. Submit a listing of all jobs in which the DEC is presently and has been involved in litigation and the status thereof.
 7. Provide a list of all jobs that your firm has been involved in liquidated damages or delay damages were filed against your firm.
 8. Submit a letter of intent to test each detention door as described in Section 111910.
 9. Submit for approval the name of the detention equipment manufacturers you intend to purchase from. Submit a current letter from the detention hardware manufacturer stating that the DEC is factory trained, fully authorized distributor and installer of their complete line of products.
 10. Provide signed statement that DEC has not been found guilty of charges relating to conflicts of interest or to any criminal activity relating to construction methods, bidding, bid rigging, or bribery in the past five years.
 11. Provide signed statement that DEC has not been found guilty of charges relating to employment of illegal aliens on construction projects in the last five (5) years.
 12. Provide a letter from 'A' rated surety company that your company will be able to provide a 100 percent Performance/Payment bond for this project if awarded the project, but not less than \$3 million dollars.
 13. Provide a financial statement for the most recent fiscal year.

1.5 ACTION SUBMITTALS

- A. A shop drawing submittal review meeting shall be held and coordinated by the General Contractor within two weeks after submittal. All participants should have at least two (2) weeks' worth of review of this first Shop Drawing submittal and be prepared to comment on its appropriateness for their assigned job efforts. The meeting shall last no longer than three (3) eight-hour days. A qualified representative from each of the following entities shall be present at the meeting:
 1. Owner
 2. Architect
 3. General Contractor
 4. Detention Equipment Contractor
 5. Security Control System Contractor
 6. Security Hollow Metal Manufacturer
 7. Security Glazing Manufacturer

8. Sliding Door Manufacturer
 9. Security Hardware Manufacturer
 10. Architectural Hardware Subcontractor
 11. Electrical Contractor
- B. Failure to follow submittal criteria will constitute submittals being non-compliant and will be reviewed as "Rejected/Resubmit". The DEC must submit the indicated and necessary shop drawing criteria for each individual specification section as an entire section and for each subsequent re-submittal.
- C. Required submittal packages shall be submitted as a complete package for each Division 11 specification section. Failure to do so will result in the submittal being "Rejected" and returned.
- D. Manufacturer's Data
1. Submit one (1) reproducible (digital format) copy of manufacturer's product specifications and installation instructions for each type of Detention Equipment.
 2. Provide product data for shop primer [and factory-applied finish(es)].
- E. Product Schedule: For detention equipment. Indicate types, quantities, sizes, and installation locations by room of each accessory required. Use same designations indicated on Drawings.
- F. Shop Drawings
1. Submit one (1) reproducible (digital format) copy of all proposed and/or specified detention equipment.
 2. Include plan and elevation layouts, construction details, embed plate locations and details, material descriptions, fastener and anchorage details, inserts, dimensions of individual components, and finishes.
- G. Samples
1. Submit (upon the Owner's or Architect's request) one (1) each sample of any or all proposed and/or specified detention equipment items, to the Owner for his review and final approval. Coordinate with the Owner's representative as to whom and where these samples are to be delivered.
- H. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for factory-applied color finishes for detention equipment and furniture.
1. Color selections will be made according to Section 013300.
- 1.6 PRODUCT HANDLING
- A. Protect units and finishes from damage during shipping, storage, handling, installation, and construction of other work in the same area.
- B. Wrap, crate, and label each item for protection from damage. Deliver pertinent items to be built-in to the General Contractor or trades in accordance with the construction progress schedule to prevent any delay.
- C. Keys shall be sent directly to the person and address as directed by the Owner, via direct mail with restricted delivery and return receipt requested.
- 1.7 GUARANTEE
- A. Upon final completion, the Manufacturer/Installer shall provide a written warranty covering detention equipment against defective materials and workmanship, and guaranteeing satisfactory operation and performance for a period of one (1) year after Substantial

Completion. The Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.

PART 2 - PRODUCTS

2.1 DETENTION EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Southern Folger Detention Equipment Co.; San Antonio, TX
 2. Modern Detention Equipment; Cincinnati, OH
 3. Willo Products Co.; Decatur, AL
 4. JAILS Correctional Products; Minster, OH
 5. Viking Products; Orange, CA
 6. Bob Barker Company, Inc.; Fuquay-Varina, NC
 7. Majestic Solutions, Inc.; Madison, AL
 8. Trussbilt; Vadnais Heights, MN
 9. Northwest Specialty Hardware, Inc. Clackamas, OR
- B. Individual Detention Equipment Items:
1. **Detention Mirror, Single & Double:** with Embedded Back Plate
 - a. Acceptable Manufacturer:
 - 1) SS No. 432/Southern Folger Detention Equip Co.
 - b. Construction:
 - 1) Mirrors:
 - a) Mirror frame shall be 11-1/4 inches by 17-1/4 inches, fabricated from 16 gauge cold finished steel, with 5/16 inch inner and outer flanges and having a tensile strength of not less than 53,000 pounds per square inch. Frame to have natural finish, chromium plated.
 - b) Mirror opening shall be 10 inches by 14 inches, made of 0.031 inch sheet steel, polished to a high degree of reflectivity, and chromium plated.
 - c) Include eight (8) chromium plated, security type, flat head machine screws, 1/4 inch diameter of proper length for use in backer plate.
 - 2) Embed Back Plates:
 - a) Provide steel embed plates and 11 gauge anchor tabs as detailed and/or required by the mirror manufacturer (refer to details on Drawings).
 2. **Detention 4-Man Table with Individual Seats:**
 - a. Construction - refer to details on Drawings:
 - 1) Provide accessible unit with only three (3) seats where indicated on drawings.
 - 2) Tabletops and seats shall be stainless steel and be smooth, true, level, and free of sharp edges. Refer to table detail for steel gauge.
 - 3) Provide checkerboard game top.
 - 4) Provide post under each seat.
 - 5) One-piece, welded assembly; all welds neatly finished.
 3. **Detention Stainless Steel Floor-Mounted Stool:**
 - a. Acceptable Manufacturer:
 - 1) Floor Mounted Stool/ Viking (modified)
 - 2) MSI-FMS/ Majestic Solutions (modified)

- 3) No. S671/Willo (modified)
 - 4) No. BB517SS / Bob Barker Co. (modified)
 - b. Construction
 - 1) Stool seat shall be 12 inches in diameter, with minimum 1-1/2 inch flange, fabricated of 16 gauge stainless steel, type 304 with No. 3 finish. The stool top shall be 1'-8" AFF.
 - 2) Seat support shall be constructed of a 2-1/2 inch diameter iron pipe, welded to a steel plate 6 inches by 11 inches by 1/4 inch for seat reinforcement. Finish paint support and plate with color(s) approved during shop drawing phase.
 - 3) Provide 12 inch by 12 inch by 1/2 inch thick anchor plate, welded to pipe support.
 - 4) Provide anchorage devices and security head fasteners. Tack weld bolts.
4. **Detention Swing Stool, Wall-Mounted:**
 - a. Acceptable Manufacturer
 - 1) Wall Mounted Stool / Willo
 - 2) No. BB518SS / Bob Barker Co. (modified)
 - 3) J-1-2528_25 / Jails Correctional Products (modified)
 - 4) Wall-mounted Stool (swing) / Trussbilt (modified)
 - b. Construction:
 - 1) Stool seat shall be minimum 12 inches in diameter, with minimum 1-1/2 inch flange, fabricated of 16 gauge stainless steel, type 304 with No. 3 finish. Seat shall be attached to a minimum 1/4 inch thick steel seat reinforcement plate.
 - 2) Seat support shall be constructed of a 3/8 inch steel plate arm, welded to a 1 inch diameter steel swivel pin and to the seat reinforcement plate.
 - 3) Provide minimum 3/8 inch thick steel embed plate; seat swing arm shall be field welded to plate.
 - 4) Provide a non-removable hinge pin for locking the seat in place.
 - 5) The stool shall lock in the 90-degree position as well as in a position that allows for accessibility requirements.
5. **Detention Stainless Steel Floor-Mounted Bench:**
 - a. Acceptable Manufacturer:
 - 1) (Custom fabricated)
 - b. Construction: Refer to details on Drawings.
 - 1) Seat shall be 11 gauge stainless steel, type 304 with No. 3 finish, with minimum 1-1/2 inch flanged edges.
 - 2) Bench supports shall be 2 inch Schedule 40 pipe, spaced no greater than 4'-0" on center, and welded to bench and base plate.
 - 3) All corners and joints shall be welded and ground smooth.
 - 4) Provide cuff rings where indicated.
6. **Transaction Drawer / Package Pass**
 - a. Acceptable Manufacturer:
 - 1) No. 1724-SCL/ Creative Industries; Indianapolis, IN
 - 2) No. 1724-SS/ Creative Industries, Inc.; Indianapolis, Indiana
 - b. Construction:
 - 1) Weather resistant Transaction Drawer that is suited for drive-up and walk-up applications.
 - 2) Provide wall sleeve sized for CMU wall thickness indicated. Modify drawer fabrication as necessary.

- 3) Coordinate with casework contractor for installation of drawer unit into casework (e.g. backsplash wrapping unit, other trim, etc.)
 - 4) Coordinate with casework contractor for recessing drawer into countertop/casework and providing flush countertop surface.
 - 5) Drawer material: Bullet resistant plastic.
 - 6) Housing: 3/4" exterior grade plywood with stainless steel on exposed surfaces providing Level 1 Bullet Resistance
 - 7) Face, hood, lid, and handle material: Stainless steel
 - 8) Lexan lid allows clear view of contents while preventing direct entry of outside air and a push button latch keeps lid locked when closed. As the drawer moves outward, the stainless steel front panel pivots upward and inward.
 - 9) Lid and front door are synchronized to open with no chance of the lid being left open when the drawer is extended. As the drawer moves outward, the stainless steel front panel pivots upward and inward. As the drawer closes, the lid returns to the slanted position, allowing the operator access to the contents.
 - 10) The drawer locks with a drop bolt located in its bottom surface.
 - 11) Handle: Stainless steel.
7. **Hopper Pass:**
- a. Acceptable Manufacturer:
 - 1) Model PHE-1/Creative Industries Inc.; Indianapolis, IN.
 - 2) Hopper Pass / Safeguard Security Services, Inc.
 - b. Construction:
 - 1) Size: 16 inches wide by 10-1/8 inches high by 7-3/4 inches deep
 - 2) Material: Stainless Steel
 - 3) Level I bullet-resistant.
 - 4) Hopper locks on staff side with a turn latch knob.
8. **Tilt-Drawer Pistol Locker: (8 - Compartment Surface Wall Mounted & Recessed Mounted)**
- a. Acceptable Manufacturer: (8-compartment)
 - 1) No. 605-8 / Southern Folger Detention Equipment Co.
 - 2) No. 770-8 / Willo Products
 - 3) No. TDGL 8C / Bob Barker
 - 4) Tilt-Out Pistol Locker (8 compartment) / Viking Products
 - 5) MS-PL8TC / Majestic Solutions
 - b. Construction:
 - 1) 3/16 inch shell and doors.
 - 2) Compartments lined with 1/8 inch felt (Verify with Owner the exact compartment size dimensions that are required to hold their jurisdiction's specific weapon type.)
 - 3) Compartment doors hung on continuous steel piano hinges.
 - 4) Provide each compartment with snap locks, each compartment individually keyed and master-keyed.
 - c. Provide anchorage devices and security fasteners.
 - d. Size/Mounting:
 - 1) Refer to details on Drawings for mounting.
9. **Recessed Toilet Paper Roll Holder:**
- a. Acceptable Manufacturer:
 - 1) SA11/ Bradley Corporation (modified)

- 2) RTH-1/Willoughby Industries, Inc. (modified)
 - 3) 1840/Acorn Engineering Co. (modified)
 - b. Construction (refer to details on Drawings):
 - 1) Recessed holder shall be 5 inches inside diameter and 4-1/2 inches deep made of 14 gauge Type 304 Stainless Steel.
 - 2) The face trim rim shall be beveled so as to fit flush with the wall surface and have an architectural satin finish.
 - 3) Four (4) anchor angles, 1 inch by 2-1/2 inches by 1/4 inch (1 inch wide) shall be welded to the exterior walls of the recessed enclosure with the 2-1/2 inch angle leg extended.
10. **Stainless Steel Counters and Work Shelves:**
 - a. Acceptable Manufacturer:
 - 1) (Custom fabricated)
 - b. Construction (Refer to details on Drawings):
 - 1) Provide stainless steel shelf as detailed on Drawings.
 - 2) Stainless steel shall be Type 304 with a No. 3 finish.
 - 3) Provide anchorage devices and security head fasteners.
 - 4) Field verify length prior to ordering
11. **Detention Grab Bars, Anti-Ligature:**
 - a. Construction (refer to details on Drawings)
12. **Detention Shower Grab Bars, Anti-Ligature:**
 - a. Acceptable Manufacturer:
 - 1) 1109 Series/Acorn Engineering Co.
 - 2) US130-G / A & J Washroom Accessories
 - 3) Model SA70-059 / Bradley Corporation
 - b. Construction (Refer to details on Drawings):
 - 1) Tubing: Provide 18 gauge, type 304 stainless steel, satin finish.
 - 2) Flanges: Minimum 11 gauge stainless steel, welded to bar.
 - 3) Closure Plate: 11 gauge stainless steel welded to underside of bar.
 - c. Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
 - d. Locate Grab Bars to comply with accessibility codes.
13. **Wall Embed Plates for detention grab bars:**
 - a. Acceptable Manufacturer:
 - 1) (Custom fabricated)
 - b. Construction (Refer to details on Drawings):
 - 1) Embed Wall Plates shall be 1/2 inch thick Stainless Steel plates dimensioned as indicated on the drawings with embedment anchor tabs.
 - 2) Grab Bars shall be bolted to embed plates as indicated on the Drawings.
14. **Detention Folding Shower Seat:**
 - a. Acceptable Manufacturer:
 - 1) No. SS2 / Viking Products.
 - 2) Model 1103-31 & 32 / Acorn Engineering Co.
 - b. Performance standards;
 - 1) Support up to 700-pound static load.
 - c. Construction:
 - 1) Provide 10 gauge, satin finish, type 304 stainless steel L-shaped seat with minimum 2" x 2" x 11 gauge channels or tubes welded to underside of seat.
 - 2) Provide minimum 1" diameter x .120 thick stainless steel tube supports and minimum 4" diameter x 3/16" stainless steel wall flanges.

- 3) Provide 10 gauge stainless steel seat catch to hold seat in upright position against the wall.
 - 4) Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
15. **Safety Shower/Clothes Hook:** (Individual Hook Assembly mounted onto a steel embed plate)
 - a. Acceptable Manufacturer:
 - 1) No. 1829 / Acorn Engineering Co. (similar).
 - 2) No. B-983 / Bobrick Washroom Equipment Inc. (similar).
 - 3) Model SA36 / Bradley (similar).
 - 4) No. 407 / Southern Folger Detention Equip Co.
 - b. Construction (Refer to details on Drawings):
 - 1) Provide 14 gauge, satin finish, type 304 stainless steel plate with stainless steel, ball-type collapsible hooks.
 - 2) Provide embed plate, drilled and tapped for security fasteners, with anchor straps.
16. **Security Steel Bar Grillage:**
 - a. Acceptable Manufacturer:
 - 1) G-S Company, Baltimore, Maryland
 - 2) Maximum Security Products Corp.; Albany, NY
 - 3) Willo Products Co.; Decatur, AL
 - b. Construction:
 - 1) Provide tool-resisting steel bar grille assemblies as per manufacturer's production practices and in accordance with ASTM A627 Standard Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities.
 - 2) Bar-grille assemblies shall consist of 7/8-inch diameter vertical double-ribbed bars spaced at 4 inches maximum on center, and 3/8 inch by 2-1/4 inch or 2-1/2 inch horizontal flat bars spaced at 12 inches on center. Perimeter framing shall be flat bars of same material and size as horizontal flat bars.
 - 3) Vertical ribbed bars shall be welded at the points they pass through the punched intermediate horizontal flat bars and surface welded to the face of perimeter framing or end anchorage angles, if provided.
 - 4) Fabricate cutouts and openings in bar-grille assemblies for penetrations of sizes and at locations indicated. Frame openings with flat bars of same material and size as horizontal flat bars.
 - 5) Frame connections with plates; use flat bars of same material and size as horizontal flat bars.
 - 6) Wall and Ceiling Anchorage: Weld framing to continuous angles with continuous welds. Anchor angles to embedded anchors by welding.
17. **Detention Shower Curtain & Track:**
 - a. Acceptable Manufacturer: 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) Secure Shower Curtain System / Derby Industries; South Bend, IN (basis-of-design)
 - 2) Clear Top Institutional Shower Curtains / Gary Manufacturing; National City, CA

- 3) Security Shower Curtain / Inpro Corp.; Muskego, WI
- 4) Sure-Check Break-A-Way Shower Curtain / Imperial Fastener Company; Pompano Beach, FL
- b. Construction
 - 1) Description: 10 gauge, pebble finish, clear vinyl with opaque white vinyl privacy panel.
 - 2) Height and Width: As indicated on Drawing.
 - 3) Mounting: Curtains shall be attached to overhead bulkheads with Velcro. Do not use curtain rods or cables.
 - 4) Curtains shall meet the requirements of NFPA 701- Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
 - 5) Demonstrate installation of curtain and attachment method.
18. All steel components shall be provided with one (1) shop coat of manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer selected for resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure, complying with performance requirements of FS TT-P-645.

2.2 DETENTION EQUIPMENT ACCESSORIES

- A. Provide accessories, anchorage inserts and security fasteners for a complete tamperproof installation.
 1. Exposed Security Fasteners:
 - a. Provide Torx-head (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - b. Finish shall match that specified of the item anchored.
- B. Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which Detention Equipment is to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Proceed with installation only after unsatisfactory conditions have corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's printed installation instructions.
- B. Touch-up painting of factory finish or factory primed items is the installer's responsibility.
- C. Do not paint stainless steel embed plates.
- D. Identify and coordinate the 'Filling of all Voids', by the General Contractor, between all materials of Detention Equipment, embeds and/or other physical construction items. Refer to specification Section 079200 – Joint Sealants and its article on "SECURITY SEALANTS" for types of sealants to be utilized.
- E. All expenses incurred by the Architect in troubleshooting Detention Equipment Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

- F. Coordinate installed equipment supplied to other contractors.

3.3 PROTECTION

- A. Protect equipment and finishes until Substantial Completion.
- B. Replace damaged equipment as directed by the Architect.

3.4 CLEANING

- A. Clean grout, mortar, and other bonding material off detention equipment immediately after installation.
- B. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections and abraded areas of shop paint is specified in Division 9 Section "Painting".
- C. Field finish painting of all equipment (not supplied with factory finish) in this section shall be done in accordance with Division 9 Section "Painting". All equipment shall be painted to match the color of its adjacent wall finish color, unless noted otherwise.
- D. Clean equipment thoroughly prior to Substantial Completion.

END OF SECTION 111900

SECTION 111910- CUSTOM / SECURITY HOLLOW METAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Detention Equipment Contractor (DEC):

1. Provide the Custom/Security hollow metal doors, door frames, window frames, and any other security hollow metal (SHM) (also referred to as Detention Hollow Metal (DHM)) components indicated on the contract document drawings, schedules, and specifications.
2. Provide all necessary embed plates and/or anchors.
 - a. Provide galvanized steel embed plates at concrete columns and other concrete construction for anchoring of SHM frames. Coordinate installation of embed plates and other anchorages. Furnish setting drawings, templates, diagrams, and instructions for items to be embedded. Deliver such items to Project site in time for installation.
3. Coordinate requirements for manual and electric hardware, monitoring and control devices, and SHM manufacturer-provided raceway/cabbling junction boxes.
4. Coordinate all electrical requirements, by the Electrical Contractor, with the Security Control Systems Contractor (SCSC) and electrical contractor.
5. Schedule installation of this work to coincide with erection of the masonry work on the project so that these contractors can grout fill the custom/security hollow metal frames as their work is erected. The DEC is responsible for providing grout and grout holes for any frames that cannot be delivered and erected by the erection contractors.
 - a. Construction Schedule: Provide a separate line for Custom/Security Hollow Metal doors and frames, which shall include adequate time for shop drawing preparation, submittal review, fabrication, and delivery of frames to the project site in time to meet above requirement and requirements of paragraph 3.2.B.2 in "Installation" article ahead. Coordinate with General Contractor.
6. Provide on-site supervision of the delivery and installation of the custom/security hollow metal doors, frames, and windows.

B. General Contractor:

1. Take delivery of the custom/security hollow metal doors, door frames, window frames, embedded plates/anchors, and store per manufacturer's recommendations.
2. Install custom/security hollow metal doors, door frames and interior/exterior window frames, as indicated.
3. Install all embedded plates and/or anchors, provided by the DEC.

C. Electrical Contractor:

1. Coordinate electrical requirements with General Contractor and DEC.
2. Coordinate this work with the control needs of the Security Control Systems Contractor (SCSC).

- D. Provide Custom/Security hollow metal work manufactured by a single firm specializing in the production of this type of work.
- E. When a fire resistance classification is indicated or scheduled for steel doors and frames, provide fire-rated doors investigated and tested as a fire door assembly, complete with type of hardware to be used. Identify each fire door with recognized testing laboratory labels, indicating applicable fire rating of steel doors.
- F. Due to security concerns, no physical U.L. Fire Resistance Labels are to be attached to the door/frame assemblies. Instead, provide die-stamped identification numbers on fire-rated doors and frames and a letter of certification recording these numbers to the Owner/user for his record and files.
- G. Fire-Rated Assemblies: Provide door and frame assemblies and window frame assemblies complying with the North Carolina Building Code and NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Test Pressure: Test at positive pressure according to NFPA 252 or UL 10C. After 5 minutes into the NFPA 252 test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill (per 2018 NC Building Code Section 716.5.1).
 - 2. Smoke and Draft Control Assemblies: Fire door assemblies located in smoke barrier walls shall also meet the requirements for a smoke and draft control door assembly tested in accordance with UL 1784. Installation of smoke doors shall be in accordance with NFPA 105.
- H. When a fire resistance classification is indicated or scheduled for steel doors and/or frames containing components that have not been tested as an assembly, the manufacturer shall construct the door and frame components of the assembly in accord with the resistance rating, and certify in writing to the Owner, Enforcing Authority, Contractor, and the Architect that the door and frame components have been constructed in accord with the testing laboratory requirements in lieu of label.
- I. Door and Panel Construction
 - 1. Field Examination:
 - a. The Custom/Security hollow metal contractor shall include in his bid the cost to provide one (1) replacement security hollow metal door that is to be selected for field testing.
 - b. When directed by the Architect, the Contractor shall destroy a randomly-selected security hollow metal door or panel by sawing it in half.
 - c. When examination discloses door construction at variance with the details specified, the door manufacturer shall replace all doors shipped to the project, as of the date of inspection, with doors constructed in conformance with project specifications.
 - d. Under conditions of nonconformity, the door manufacturer shall pay for the destroyed door and related labor.
 - e. When examination proves that the door was constructed in conformance with specifications, the Detention Equipment Contractor (DEC) shall immediately proceed to provide the replacements for the destroyed door.
 - 2. All detention doors and panels for this Contract shall be constructed as specified and to meet the following ASTM Testing.
 - a. The following tests (ASTM F 1450 – 12a, Grade 3) shall be conducted by an independent testing laboratory, upon doors with documentation attesting to

compliance with the detention door construction required and indicated in this section.

- b. Doors for these tests shall utilize 14 gauge face sheets, 12 gauge frames, 3 feet by 7 feet (nominal size), not exceeding 225 lbs. in weight, and shall be fabricated as Door Type "DN" without a food pass (refer to Detention Door Types on Drawings).
 - 1) Test A – Door Static Load Test:
 - a) Door shall be end supported and loaded at quarter points by a total load of 11,000 pounds for a period of one (1) minute. Door shall deflect not more than 0.580 inch (14.73 mm) and shall rebound to within 0.100 inch (2.55 mm) of flatness after the loading is removed.
 - 2) Test B – Door Rack Test:
 - a) Door shall be secured at one short dimension and support at one other short dimension; unsupported corner shall be loaded for 30 seconds with a load of 5,500 pounds. Results should be as follows: Unsupported corner's measured deflection shall not exceed 3.55 inches (90.52 mm). Rebound to within 1.40 inches (35.7 mm) of flatness with no visual signs of weld failure.
 - 3) Test C - Door Assembly Impact Test:
 - a) 3'-0" x 7'-0" door, frame, and hardware assembly shall be constructed and rigidly mounted in the vertical position such that the door and locking hardware are operable. The door shall swing on 1-1/2 pair of full mortised butt hinges, and shall be locked using a Southern Steel No. 1070, 1080 or 10120 series lock or equal, with bolt size not to exceed 2 inch high x 3/4 inch wide, and latch throw not to exceed 7/8 inch.
 - b) A door ram pendulum system, capable of delivering consistent impacts of up to 200 feet lb., shall be constructed such that impacts may be delivered to any area of the assembly. The pendulum ram system shall be positioned opposite the door side of the assembly such that the door swings away from the ram. While hanging at rest, the ram shall be positioned such that the striking nose just touches the target area of the door. The striking nose shall be made from C1010-1020 low carbon steel, the striking surface area of which shall not exceed 4.0 square inches +/- 0.04 square inches.
 - c) With the door closed and locked and the above testing arrangement secured, the following series of impact tests shall be performed from the push side of the assembly:

Position and Order of Impacts	Number of Impacts	Impact Energy (ft. lbs.)
On door at center line of bolt, 6" from door edge	200	200
On door within 6" of bottom hinge	75	200
On door within 6" of center hinge	75	200
On door within 6" of top hinge	75	200
On the glass within 1.6" of the lower lock edge corner	100	200

- d) The door shall remain closed and locked throughout the testing procedure, and the assembly shall not be damaged such that forcible egress can be obtained. After testing is completed, the door shall be capable of being unlocked and operated such that normal egress can be obtained.
- 4) Test D - Door Edge Crush Test:
 - a) Door shall be placed in test fixture, hinge side up. Apply pressure perpendicular to door edge until required loads are reached. Remove the door from the framework and place the door back into the test fixture, with the lock side up, and then repeat the test procedure. Required results: Both the hinge and lock edge shall support a load of at least 8,000 lbf with a deflection of less than 0.25 inch (6mm).
- 3. References:
 - a. American Society of Testing and Materials (ASTM Standards F1450 and F1592)
 - b. National Association of Architectural Metal Manufacturers (NAAMM)
 - c. Hollow Metal Manufacturers Association (HMMA Standard 863)
 - d. Underwriters Laboratories (UL)

1.3 ACTION SUBMITTALS

- A. Required submittal for Custom/Security Hollow Metal Work shall be submitted as a complete package. Failure to do so will result in the submittal being "Rejected" and returned.
- B. Manufacturer's Data
 - 1. Submit one (1) reproducible (digital format) copy of manufacturer's product specifications and installation instructions.
- C. Shop Drawings:
 - 1. Submit one (1) reproducible (digital format) copy of all proposed and/or specified custom security/detention hollow metal work, and elevation layouts.
 - 2. Include dimensional construction details of each frame type, elevations of door and frame design types, conditions at openings, fastener, anchorage, and reinforcement details. Provide details of lock pockets and factory fabricated accessories, including, but not limited to, food passes and lockable paper passes, location & installation requirements of finish hardware & reinforcements, and details of joints and connections. Provide details of doors, including vertical and horizontal edge details, and metal thicknesses.
 - 3. Drawings shall use the same plan and elevation numbers as indicated on the contract document drawings.
- D. Certificates:
 - 1. Manufacturer shall submit a certificate, individually dated and signed by hollow metal manufacturer, certifying that all materials meet specification requirements.
 - 2. Welder certificates signed by Contractor certifying that welders comply with requirements (Section 4 of ANSI/AWS D1.3) specified under "Quality Assurance" article.
- E. Owner's Tools
 - 1. Furnish five (5) security fastener tools for each different type of security fastener, being utilized, at the time of Substantial Completion.

1.4 JOB CONDITIONS

- A. Hardware Coordination Conference: Refer to Finish Hardware and Security Hardware Specification Sections.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle hollow metal work per manufacturer's requirements.

1.6 GUARANTEE

- A. Upon Final Completion, the Manufacturer/Installer shall provide a written warranty covering the custom / security hollow metal work against defective materials and workmanship and guaranteeing satisfactory operation and performance for a period of one (1) year after Final Completion. The Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OF CUSTOM/SECURITY HOLLOW METAL:

- A. Manufacturers should submit evidence of successful detention facility experience within the last five years, and a list of projects of scope comparable to or larger than this project completed within the last five years, with Owner, Architect, and General Contractor contact names and telephone numbers.
1. Claborn Manufacturing Co.; Hartselle, AL.
 2. Trussbilt (Trussbilt/American); Vadnais Heights, MN
 3. American Steel Products (Trussbilt/American); Swainsboro, GA
 4. Titan Steel Door, LLC; Gainesville, GA

2.2 MATERIALS

A. FERROUS METALS

1. Metal Surfaces, General: For hollow metal work exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
2. Steel Plates, Shapes, and Bars: ASTM A 36.
3. Uncoated Structural Steel Sheet:
 - a. Provide sheet steel types (manufacturing method), quality, and grade, as follows:
 - 1) Cold-Rolled Structural Steel Sheet: ASTM A1008/ A1008M, or as noted or required for loading.
 - 2) Hot-Rolled Structural Steel Sheet: ASTM A1011/ A1011M, unless otherwise noted or required for design loading rolled.
4. Uncoated Steel Sheet: Commercial quality, cold-rolled steel sheet, ASTM A 366.
5. Hot-Rolled Steel Sheet: ASTM A 1011.
6. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

7. Gray Iron Castings: ASTM A 48, Class 30.
8. Malleable Iron Castings: ASTM A 47, grade 32510.
9. Brackets, Flanges and Anchors: Metal to match material and finish of supported rails, or as noted.
10. Concrete Inserts: Threaded or wedge type; galvanized ASTM A 47 malleable iron or ASTM A 27 cast steel castings. Provide ASTM A 153 hot-dip galvanized bolts, washers, and shims as required.
11. Welding Rods and Bare Electrodes: Select as per AWS specifications for the metal alloy to be welded.
12. Fasteners: General: Provide Torx-head (star design with center reject pin) security fasteners for anchoring work in exposed security areas. Provide one hundred (100) additional security glazing stop fasteners.
13. Shop Primer for Ferrous Metal (alkyd based): Manufacturer's or fabricator's standard, fast-curing, lead-free, universal modified alkyd primer selected for resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-645. If the Shop Primer described above is provided instead of the Phenolic-Phosphate based water primer described in item No. 13 below, then all interior surfaces of the hollow metal frame assembly's jambs, heads and sills are to receive a coating of water based coating of Aqueous Automotive Corrosion Control Coating Terotex No. 895213 by Henkel Surface Technologies (or equal).
14. Shop Primer for Ferrous Metal: Interior doors and frames shall be thoroughly cleaned, degreased, bonderized, and provided with one coat of North American Technologies No. 40-P-1802 (or equal) primer.
 - a. PRIMER Specifications:
 - 1) Phenolic Water Based Primer
 - 2) Product Number: 40-P-1802
 - 3) Description: Phenolic phosphate based water primer designed for use in extremely corrosive building applications.
 - 4) Application: Apply by brush, roller, spray, or dip.
 - 5) Percent solids per weight: 50 percent +/- 2
 - 6) Weight/Gallon; 8.93
 - 7) PVC: 39 percent
 - 8) Gloss 60 degree: 0 degree
 - 9) Salt Spray: 200 hours @ 1.5m
 - 10) Recommended Film Thickness: 0.8 – 1.5m
 - 11) Color: Gray or Beige
 - 12) Rust Inhibitive Pigment: Zinc Phosphate
 - 13) Application Use: Primer shall be used over properly cleaned, rust free steel for proper rust inhibition. Steel should be stored in a dry environment, protected from damage to surface. Steel must be top coated within one (1) month of arrival with any commercially available top coat, water based or solvent based.

2.3 FABRICATION

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated

or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Remove sharp or rough areas on exposed traffic surfaces.
- F. Weld corners and seams continuously to comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Torx-head flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- I. Shop Assembly:
 - 1. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Cut, reinforce, drill, and tap fabricated work as indicated to receive finish hardware, screws, and similar items.
 - 2. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles as indicated on drawings.
 - 3. After fabrication, interior and exterior doors and frames shall be thoroughly cleaned, degreased, bonderized, and provided with one coat of shop primer.
 - 4. Fabricate exterior doors, panels, and frames from galvanized sheet steel.
 - 5. Clean, treat, and paint exposed, galvanized surfaces of fabricated hollow metal units.
- J. Finish Hardware and Security Items Preparation:
 - 1. Templates for all hardware attachments and security items shall be provided by the hardware suppliers to the Detention Equipment Contractor (DEC) for transmittal to the frame and door manufacturer.
 - 2. Fabricate frames with mitered corners, welded continuously and ground smooth. Frames and doors shall be mortised, reinforced, machined, and prepared for all hardware.

2.4 HOLLOW METAL DOORS

- A. Provide hollow metal doors of the types and styles indicated on the drawings and schedules. Furnish detailed accessory items such as food pass.
- B. All hollow metal doors shall have a flush closed top edge and bottom edge.
- C. Size/Thickness/Type: Refer to Detention Door Schedule and Detention Door Types.
- D. Gauge: 14 gauge face sheets.
- E. Coordinate electric hardware requirements to be integrally built into the door with the hardware requirements.
- F. Internal Core Construction: Provide one of the following two (2) types:
 - 1. Steel-Stiffened Core: Steel stiffened by continuous vertically formed steel hat sections, which upon assembly, shall span the full thickness of the interior space between door faces. Stiffeners shall be 16 gauge (minimum) to meet the performance standards established in the quality control section of this specification, spaced such that the vertical interior webs shall be no more than 4 inches o.c. and securely fastened to both face sheets and together by spot welds spaced a minimum of 2-1/2 inches o.c. vertically. Spaces between stiffeners shall be filled with 3 lbs./cu. ft. fiberglass or mineral Rockwool batt-type material.
 - 2. Truss-Stiffened Core: Continuous, inner-reinforcement full height and width shall be true truss design with triangular form, the shape of which cannot be altered without changing the length of the sides. Flat apexes shall be resistance spot welded on 2-3/4 inch centers horizontally and 3 inch centers vertically. Each flute of reinforcement to be fire and sound insulated with 6 lbs./cu. ft. Rockwool batt-type material.
- G. Top and Bottom Channels: The top and bottom edges shall be closed with a continuous channel, not less than 12 gauge, welded to both face sheets at a minimum of 4 inches o.c. Reinforce the top closing end channel with an additional 12 gauge flush closing channel full width continuously welded to the vertical edge of the door at all four corners and at the center.
- H. Vertical Edges:
 - 1. All vertical edges shall be reinforced by a continuous steel channel, not less than 12 gauge, extending the full length of the door. Continuously weld and finish smooth edge seams without visible joints or seams on exposed faces or stile edges.
 - a. For single-acting swinging detention doors, lock and hinge edges shall be beveled 1/8 inch in 2 inches.
 - b. For sliding detention doors, square both vertical edges.
- I. Exterior Doors:
 - 1. Fabricate exterior doors of two outer, galvanized, stretcher-leveled, steel sheets. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges, except around glazed or louvered panel inserts. Provide weep hole openings in the bottom of exterior doors to permit the escape of entrapped moisture.
- J. Interior Doors.
 - 1. Fabricate interior doors of two outer, cold-rolled, stretcher-leveled, steel sheets. Construct doors with smooth, flush surfaces, without visible joints or seams on exposed faces or stile edges.
- K. Finish Hardware Reinforcement:
 - 1. Hinges: Steel plate 3/16 inch thick by full height, secured by spot-welds 4 inches o.c.

2. Mortise Locksets and Dead Bolts: 3/16 inch thick steel sheet, welded to inside of door on detention side (cell side) and 3/16 inch thick steel lock mounting plate, beveled at edges, applied to the surface of the door with security screws.
 3. Cylinder Locks: 12 gauge steel sheet, secured with not less than 2 spot-welds.
 4. Flush Bolts: 12 gauge steel sheet, secured with not less than 2 spot-welds.
 5. Surface-Applied Closers: 12 gauge steel sheet, secured with not less than 6 spot-welds.
 6. Push Plates and Bars: 16 gauge steel sheet (except when through bolts are indicated or specified), secured with not less than 2 spot-welds.
 7. Surface Panic Device: 14 gauge sheet steel (except when through bolts are indicated or specified), secured with not less than 2 spot-welds.
 8. Automatic Door Bottoms: Reinforce for mortise-type units with 12 gauge steel, and 16 gauge for surface-applied units.
 9. Vision Panels: 12 gauge steel sheet around perimeter, welded 3 inches o.c. field installed.
- L. Removable glass stops shall consist of 10 gauge "Z"-type stops securely fastened to the door using Torx-head (star with center reject pin) security screws of the size, strength and spacing necessary to satisfy impact performance criteria.

2.5 HOLLOW METAL FRAMES

- A. Provide custom/security hollow metal door frames of the types and styles indicated on the drawings or schedules, interior and exterior. Conceal all anchorage, unless noted otherwise.
- B. Provide custom/security hollow metal frames for windows, transoms, side lites, borrowed lites, and other openings as indicated on the drawings, interior and exterior. Conceal all anchorage, unless noted otherwise.
- C. Provide galvanized frames at exterior locations and as indicated in the Detention Door Schedule.
- D. Fabricate frames with mitered corners continuously welded through head inside corner and miter ground smooth.
- E. All frames shall be provided with approved jamb anchors (4 per jamb minimum), floor knees, plaster boxes (26 gauge steel minimum), removable angle spreaders, and door silencers (3 Glynn Johnson GJ64 silencers minimum per door) by the manufacturer. Continuous floor anchors below glazing shall be 12 gauge minimum with holes for fasteners at 12 inches on center.
- F. Types: Refer to Detention Door Schedule and Detention Frame Elevations.
- G. Gauge: 12 gauge.
- H. Finish Hardware Reinforcement: Reinforce frames for required finish hardware, as follows:
 1. Hinges and Pivots: Hinge Reinforcing Steel plate 3/16 inch thick by 2 inches wide by 10 inches long welded to the inside of the frame and a Back-Up Angle 3/16 inch thick welded to the Hinge Reinforcement steel plate and to the frame at both its ends. Back-Up Angle shall be drilled and tapped to accommodate security screws to fasten the security hinges.
 2. Strike Plate Clips: Steel plate 3/16 inch thick by 1-1/2 inches wide by 3 inches long.
 3. Surface-Applied Closers: 12 gauge steel sheet, secured with not less than 6 spot-welds.
 4. Provide lock pockets as indicated and required.

- I. Removable glass stops shall consist of 10 gauge angles securely fastened to the frame using Torx-head (star with center reject pin) security screws of the size, strength and spacing necessary to satisfy impact performance criteria. During shipment of these assemblies, non-security fasteners may be substituted to hold glass stops in place. The security fasteners shall be included in the same shipment but packaged separately for protection until used to stop in the required glazing.
- J. Provide grout openings for all vertical or horizontal hollow metal frame sections that are not accessible for grouting due to steel lintels or other obstructions.
- K. Provide separate conduit systems for door control, intercom, etc., within hollow metal frames.

2.6 ELECTRICAL REQUIREMENTS

- A. Custom/security hollow metal fabricator shall furnish and install junction boxes and conduit between junction boxes in door frames for electric locks, door position switches, emergency release buttons, and intercom call stations; coordinate special hardware requirements with the Electrical Contractor and Security Hardware Subcontractor.
- B. Refer to the Detention Door Schedule(s), Security Hardware Specification Section, and Details.

2.7 SECURITY/DETENTION EQUIPMENT ACCESSORIES

- A. Provide accessories, anchorage inserts, and security fasteners for a complete, tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Provide Torx-head (star design with center reject pin) security fasteners for anchoring work in exposed security areas. Provide one hundred (100) additional security glazing stop fasteners.
 - 2. Finish shall match that specified of the item anchored.
 - 3. Provide three (3) sets of tools for each type of security fastener used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which steel doors and frames are to be installed. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install hollow metal units and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.
- B. Placing Frames:
 - 1. Comply with the provisions of S.D.I. 105.
 - 2. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed and aligned (using metal shims), and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

3. Identify and coordinate with the work of Section 079200 – Joint Sealants to assure the ‘Filling of all Voids’ around the perimeter of custom/security hollow metal frames. Refer to specification Section 079200 – Joint Sealants and its article on Security Sealants for types of sealants to be utilized.
 4. Install fire-rated frames in accordance with NFPA 80.
 5. Grout fill solid all custom/security hollow metal frame jambs, sill, and head sections. Provide grout openings in hollow metal frames where access for grout filling of frame sections may be restricted due to steel lintels or other obstructions. Prior to filling jamb, head, and sill frame sections with grout, verify that the required Phenolic Water Based Primer has properly coated all interior surfaces. If the primer coating is omitted or damaged, field apply a coating of the Phenolic Water Based Primer.
 6. If the supplied Shop Primer is a universal modified alkyd primer, instead of the Phenolic-Phosphate based water primer, below, then all interior surfaces of the hollow metal frame assembly’s jambs, heads, and sills are to receive a coating of water-based coating of Aqueous Automotive Corrosion Control Coating Terotex No. 895213 by Henkel Surface Technologies (or equal).
 7. Prior to filling intermediate frame sections with grout, verify that the required Phenolic Water Based Primer has properly coated all interior surfaces. If the primer coating is omitted or damaged, field apply a coating of the Phenolic Water Based Primer.

NOTE: If the supplied Shop Primer is a universal modified alkyd primer, instead of the Phenolic-Phosphate based water primer, below, then all interior surfaces of the hollow metal frame assembly’s jambs, heads and sills are to receive a coating of water based coating of Aqueous Automotive Corrosion Control Coating Terotex No.895213 by Henkel Surface Technologies (or equal).
 8. In masonry construction, locate four (4) wall anchors per jamb at hinge and strike levels. Setting of anchors and grout filling of frame jambs is specified in Division 4 Sections “Unit Masonry” and “Reinforced Unit Masonry” as applicable.
- C. Door Installation:
1. Fit custom/security hollow metal doors accurately in their respective frames with the following clearance tolerances or as indicated on the Detention Door Schedule (utilize clearances specified in S.D.I. 100 for applications not listed below):
 - a. Jambs and Head: 1/8 inch +/- 1/16”
 - b. Meeting Edges, Pair of Doors: 1/8 inch 1/8 inch +/- 1/16”
 - c. Bottom: 3/8 inch (when no carpet or threshold)
 - d. Bottom: 1/8 inch (when having carpet or threshold)
 2. Sliding Detention Doors: Fit sliding detention doors in their frames according to manufacturer's written instructions and as required to allow doors to slide without binding.
 3. Install fire-rated doors per NFPA 80 (or per local applicable codes, if more stringent).
- D. All expenses incurred by the Architect in troubleshooting the Custom / Security Hollow Metal Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

3.3 ADJUST AND CLEAN

- A. Final Adjustments:
 - 1. Check and readjust operating finish hardware items in hollow metal work immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors or frames which are warped, bowed, or damaged or otherwise unacceptable.
- B. Clean grout and other bonding material off detention doors and frames immediately after installation.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M
- D. Prime Coat Touchup:
 - 1. Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
 - 2. After finishing smooth field welds, apply air-drying primer.

END OF SECTION 111910

SECTION 111950 - SECURITY GLASS AND GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Detention Equipment Contractor (DEC):
 - 1. Provide security glass and glazing work as indicated.
 - 2. Applications of security glass and glazing include the following:
 - a. Security glazing of interior and exterior doors.
 - b. Security glazing of interior and exterior hollow metal frames and miscellaneous interior security glazed frames.
 - c. Insulating security glazing in exterior openings.
 - d. Security glazing at Security Desk in Lobby. General Contractor:
 - 3. Coordinate efforts of security glazing with other glazing work and the installation of security hollow metal work.

1.3 GLAZING CRITERIA PERFORMANCE REQUIREMENTS

- A. Security Glass:
 - 1. Comply with multiple impact and high energy impact tests:
 - a. UL 972
 - b. ASTM F 1233.
 - c. ASTM F 1915.
- B. Bullet Resistant Glass:
- C. Comply with UL 752. Provide glazing, listed and labeled by UL for the required rating.
- D. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated:
 - 1. Design Procedure for Glass: ASTM E 1300 and ICC's International Building Code.
 - 2. Design Wind Pressures: As indicated on Drawings.
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with Safety Standard for Architectural Glazing Materials; 16 CFR Part 1201, Category II.
- F. Windborne-Debris-Impact Resistance: Exterior glazing shall conform to enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 2 tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
 - 1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
 - 2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade
- G. Security Polycarbonate:
 - 1. Comply with ASTM F 1233 containment test body passage or contraband passage level as described in Security Glazing "Compositions" section.

2. Comply with ASTM F 1915 containment test using pendulum impact having blunt, sharp and axe heads with heat /fire (torch) applied.
3. Bullet resistant products shall be tested and listed by UL 752 or ASTM F 1233, whichever is applicable and certified to by the manufacturer of the security glazing.
4. Maintenance serviceability test, all types:
 - a. Products will not exhibit abrasion haze of more than 15 percent when tested to ANSI Z26.1. Taber Abrader test No. 17 for 100 cycles having a 500 gram load.
 - b. No extraordinary procedures shall be required for window cleaning. Manufacturer's recommendations shall be followed.

H. Experience Criteria:

1. Minimum of five (5) years' experience manufacturing specified item.
2. Minimum of five (5) years successful installations on detention and correctional facilities.
3. Security glazing manufacturer approval:
 - a. No security glazing manufacturers will be approved after the bid date. All manufacturers must submit qualifications to the Architect for consideration no less than fifteen (15) days prior to bid date.

1.4 ACTION SUBMITTALS:

- A. Required submittals for this section shall be submitted as one complete package. This shall include, but not be limited to, manufacturer's data, shop drawings, and samples. Failure to do so will result in the submittal being "Rejected" and returned.
- B. Manufacturer's Data – Glass and Glazing:
 1. Submit one (1) reproducible (digital format) copy of manufacturer's specifications and installation instructions for each type of glass, setting blocks, sealants, and gaskets required.
 2. Include test data substantiating that glass complies with specified requirements.
 3. Indicate by copy of transmittal that Glazier has received copy of handling and glazing instructions.
- C. Manufacturer's Data - Glazing Materials:
 1. Submit one (1) reproducible (digital format) copy of manufacturer's specifications and installation instructions for each type of glazing, sealant, tape, compound, gasket and associated miscellaneous material required. Include manufacturer's published data, letter of certification, or certified test laboratory report indicating that each material complies with the requirements as is intended generally for the applications indicated.
 2. Indicate by copy of transmittal that Glazier has received copy of each glazing component's recommended installation instructions.
- D. Shop Drawings:
 1. Submit FULL SCALE hollow metal sill glazing installation detail drawings. Details shall indicate the actual glazing products being supplied (i.e. setting blocks, sealants, gaskets), their actual sizes, their placements/spacing and their dimensional relationships within the assembly.
 - a. Provide details for fire-rated and non-fire-rated security glazing.
 - b. Provide details for exterior security glazing.

- E. Security Glazing Schedule: List glazing types for each opening and location. Use same designations indicated on Drawings.
 - F. Glazing Samples: For the following products; 12 inches square, two (2) samples of each type:
 - 1. Type INSG-1.
 - G. Shading Film product data and samples: Submit one (1) reproducible (digital format) copy of manufacturer's data and two (2) sets of samples of interior-applied, shading "Films" being considered for glazing types indicated to receive it (refer to Security Glazing types).
 - H. Sample Warranties: For security glazing.
- 1.5 JOB CONDITIONS
- A. Weather Conditions:
 - 1. Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for sealant installation.
- 1.6 WARRANTY
- A. Security Glass:
 - 1. Provide Owner a five (5) year guarantee for materials and labor from date of Substantial Completion for all security glazing.
 - 2. Guarantee shall include delamination.
 - 3. The guarantee shall be by the manufacturer, co-signed by the Installer and Detention Equipment Contractor.
 - 4. Manufacturer's warranty on laminated polycarbonate:
 - c. Provide written warranty by the manufacturer of mar-resistant laminated polycarbonate agreeing to supply replacement product, FOB point of manufacture, freight allowed to project site, in the event of material failure due to manufacturing defect. Defect shall be defined as edge separation, delamination, breakage or coating failure. Time period for said warranty shall be a minimum of five (5) years.

PART 2 - PRODUCTS

2.1 GLAZING TESTING CRITERIA

- A. Security Glazings:
 - 1. Comply with ANSI standard Z-97.1-2009 Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test.
 - 2. Comply with and pass UL multiple impact test.
 - 3. Comply with and pass UL high energy impact test.
 - 4. Comply with ASTM F1915 Standard Test Methods for Glazing for Detention Facilities.
- B. Security Polycarbonates:
 - 1. Types: Laminated or monolithic polycarbonate sheet shall be extruded sheet, UV stabilized, but when laminated uses an interlayer of 0.030 inch "LR" resin. Material layups will vary according to manufacturer's requirements to meet constructions listed in Security

Glazing Compositions section. Polycarbonate laminates shall have a flexural strength not less than 13,500 psi (ASTM D790, 180 degrees F continuous service temperature). Products must conform to the International Building Code (IBC) as an approved light transmitting plastic with a CC-1 flammability performance rating.

- C. APPROVED MANUFACTURERS: (SUBJECT TO COMPLIANCE WITH PERFORMANCE)
1. Global Security Glazing; Selma, AL
 2. DLUBAK Corp; Blairsville, PA
 3. LTI Group; Pittsfield, MA
 4. McGrory Glass; Paulsboro, NJ

2.2 SECURITY GLAZING COMPOSITIONS

A. Security Insulating-Glass Units:

1. Provide factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified according to ASTM E 2190.
2. **Type INSG-1:** Outdoor lite is made of monolithic glass and indoor lite is made of glass-clad polycarbonate. 1-3/4" inch nominal, Low-E coated clear insulating glass unit; outdoor lite is 1/4" Kind FT (fully tempered) clear float glass with Low-E coating on second surface, 1/2" insulating air space, indoor lite shall be Security Glazing Type SG-11 – refer to 2.2.C.1 below. Low-E coating shall match Glass Type G-2, as specified in Section 088000.

B. Polycarbonate Sheet Glazing:

1. **Type SG-1P** – 3/4 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 1, 60 minute containment rated; Global Security Glazing RC 750 or approved equal.
2. **Type SG-2P** – 1/2 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 2, 40 minute containment rated; Global Security Glazing MPC 500 or approved equal.
3. **Type SG-3P** - 3/8 inch nominal, multi-ply clear polycarbonate, ASTM F1915 Grade 3, 20 minute containment rated; Global Security Glazing MPC 375 or approved equal.

C. Glass Clad Polycarbonates:

1. **Type SG-11** - 15/16 inch nominal, 1/8 inch heat strengthened glass, 1/8 inch clear polycarbonate, 1/4 inch clear polycarbonate, 1/8 inch clear polycarbonate, 1/8 inch heat strengthened glass. ASTM F1915 Grade 2, 40 minute containment rated; Global Security Glazing 2114 or approved equal.
2. **Type SG-12** – (NOT USED)
3. **Type SG-13F** – 1-3/4" nominal thickness; Proprietary multi-layer construction comprised of glass-clad polycarbonate and fire-resistant glass laminate. Apply the shading "Film" on the glazing surface away from the inmate occupancy and after the building has received its Certificate of Occupancy. The shading "film" color is to be selected by the Owner under the supervision of the Architect. 45 minute fire rated, ASTM F1915 Grade 1; Global Security Glazing – Inferno-Lite ULTIMAX 45-SP028-G or INFERNOGARD 45-SP028
4. **Type SG-14F** - 1-1/8 inch nominal, 1/4 inch wire glass, 1/8 inch clear polycarbonate, 3/8 inch clear polycarbonate, 1/8 inch clear polycarbonate, 1/4 inch wire glass. 45 minute fire rated, ASTM F1915 Grade 1; Global Security Glazing – ICGCP 2416WW.

5. **Type SG-15F** - 1-1/8 inch nominal, 1/4 inch wire glass, 1/8 inch clear polycarbonate, 3/8 inch clear polycarbonate, 1/8 inch clear polycarbonate, 1/4 inch wire glass. 90 minute fire rated, ASTM F1915 Grade 1; Global Security Glazing – ICGCP 2416WW90.
6. **Type SG-16F** - 1” nominal, 1/4” wire glass, 1/4” clear polycarbonate, 1/8” clear polycarbonate, 1/4” wire glass. 45 minute fire rated, ASTM F1915 Grade 2; Global Security Glazing – FRP-4540.
7. **Type SG-17F** – (NOT USED)
8. **Type SG-18F** – (NOT USED)
9. **Type SG-19F** – (NOT USED)
10. **Type SG-20** – 1-1/8” nominal, UL 752 Level 3 Bullet Resistant Glazing; Global Security Glazing – SP311.
11. Wire Glass for Glass-Clad Polycarbonates: Provide square mesh pattern.

D. **“Shading Film” Manufacturers:**

1. Madico Window Films Madico, Inc.; St. Petersburg, FL (727) 327-2544 or (888) 887-2022
2. Aegis Films, Inc.; Norcross, GA (770) 417-1281
3. LLumar Solar Control Window Film; Bassett, VA (276) 629-1711
4. MaxPro Window Films; Whiteville, NC (877) 573-3456
5. Sun Block, Inc.; Midlothian, VA (804) 379-4123
6. X-RAYZ Window Tinting; Charlottesville, VA (434) 296-0176
7. Vista Window Film/CP Films, Inc.; Martinsville, VA (888) 273-4567
8. Film Technologies International, Inc.; St. Petersburg, FL (727) 327-2544

2.3 GLAZING SEALANTS/COMPOUNDS

A. Basic Requirements:

1. Provide black exposed glazing materials, unless another color is indicated, or unless another color is selected by Architect from manufacturer's standard colors.
2. Provide hardness of materials as recommended by the manufacturer for the required application and condition of installation in each case.
3. Provide only compounds known (proven) to be fully compatible with surfaces contacted.
4. Provide sealants recommended by manufacturer of glazing type specified.
5. Provide silicone sealant bead along entire glazing perimeter, between glazing and stops (removable and non-removable), installed with a substantial “wash” away from security glazing, providing a watertight seal from detergents and cleaning solutions.

B. Silicone Rubber Glazing Sealant:

1. Silicon rubber, one part elastomeric sealant, complying with FS TTS001543, Class A. Provide acid-type for porous channel surfaces, and provide non-acid type for porous channel surfaces (where any of the channel surfaces are porous).

- C. Butyl Rubber Glazing Tape:
 - 1. Partly vulcanized, self-adhesive, non-staining, elastomeric butyl rubber tape, 98 percent solids, intended for 35 percent compression, non-appreciable deterioration for 3000 hour test in Atlas Weatherometer.
- D. One Component Urethane Glazing Sealant:
 - 1. Solvent based, one component polyurethane; compounded specifically for glazing; complying with FS TT200230, Class A, Type 11.
- E. Acrylic Latex Glazing Compound:
 - 1. Modified latex rubber and acrylic emulsion polymer, compounded specifically as a glazing sealant with permanent flexibility (non-hardening), non-staining, and non-bleeding.
- F. Butyl Rubber Glazing Sealant:
 - 1. Polymerized butyl rubber compound with inert fillers and pigments, solvent based with 75 percent solids, non-sag, tack-free within twenty-four (24) hours, paintable, non-staining.
- G. Preformed Butyl rubber Glazing Sealant:
 - 1. Tape or ribbon (coiled on release paper) of polymerized butyl, or mixture of butyl and polyisobutylene, compounded with inert fillers and pigments, solvent based with minimum of 95 percent solids, with thread or fabric reinforcement, tack-free within twenty-four (24) hours, paintable, non-staining.
 - 2. Provide combination type and encased continuous rubber shim, of approximately 50 durometer hardness.

2.4 GLAZING GASKETS

- A. Provide glazing gaskets as recommended by manufacturer.
- B. Structural Rubber Glazing Gaskets:
 - 1. Neoprene extrusions with injection molded corner units, fabricated into frames, with either integral or separate locking strips (zippers); comply with ASTM C542, black.
- C. Molded Neoprene Glazing Gaskets:
 - 1. Molded or extruded neoprene gaskets of the profile and hardness required for watertight construction; comply with ASTM D 2000 designation 2BC 415 to 3BC 620, black.
- D. Polyvinyl Chloride Glazing Gaskets:
 - 1. Extruded, flexible PVC gaskets of the profile and hardness shown, or as required for watertight construction; comply with ASTM D 2287.
- E. Vinyl Foam Glazing Tape:
 - 1. Closed cell, flexible, self-adhesive, non-extruding, polyvinyl chloride foam tape; recommended by manufacturer for installation of glass, with only nominal pressure in the glazing channel; comply with ASTM D 1667.
- F. Glazing Sealants - Materials specifically for polycarbonates:
 - 1. General
 - a. Provide products and materials of the type indicated and approved for use with the specified security glass polycarbonate products.
 - b. Comply with recommendations of the manufacturers of each type of glazing material for the storage, installation, and finishing of respective products.

2. Compatibility
 - a. Install using sealants of proven compatibility with the various surfaces in which they will come in contact with, including all submitted silicones, setting blocks, glazing tape, and edge block materials.
 - b. Provide sealants of the color specified, or from manufacturer's standard as chosen by the Architect.
3. Materials
 - a. Silicone sealants shall be single component elastomeric silicone complying with the following:
 - 1) FS TT-S-001543A (COM-NBS), Class A, non-sag.
 - 2) ASTM C 920, Type S, Grade NS, Class 50, Use G for high modulus silicone.
 - 3) DOWSIL 995 Silicone Structural Sealant or equal.
 - b. Glazing tape shall be pre-formed polyisobutylene butyl sealant, Tremco 440, Tremco Polyshim II, or equal.
 - c. Setting blocks shall be neoprene or EPDM (70 to 90 durometer) 3 inches to 4 inches long.
 - d. Edge blocks shall be neoprene, EPDM or silicone (40-50 durometers) and of a size and spaced as to prevent lateral movement.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. Setting Blocks:
 1. Neoprene, 7090 durometer hardness, proven compatible with sealants used.
- B. Spacers:
 1. Neoprene 4050 durometer hardness, with proven compatibility with sealants used.
- C. Compressible Backer Rod:
 1. Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 510 psi compression strength for 25 percent deflection.
- D. Self-adhesive, Compressible Filler:
 1. Closed cell, polyvinyl chloride foam compressible filler, size 1/2 inch thick by full depth of intermediate composite tube section; color-black. Provide with pressure sensitive adhesive on one side for attachment to tube section. Compressible filler as manufactured by Tremco.
- E. Cleaners, Primers, and Sealers:
 1. Type recommended by sealant or gasket manufacturer.
- F. Exposed Security Fasteners:
 1. Provide Torx-head (star design with center pin) security fasteners for anchoring work in exposed security areas.
 2. Finish shall match that specified of the item anchored. (Do not paint Torx- heads.)
 3. Provide three (3) sets of tools for security fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed. Notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the glazing until unsatisfactory conditions have been corrected.

3.2 STANDARDS AND PERFORMANCE

- A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
- B. Protect glass from edge damage during handling, installation and operations of the building.
- C. Glazing channel dimensions are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. The Glazier is responsible for correct size for each opening, with the tolerance and necessary dimensions established.
- D. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer's technical representatives direct otherwise.
- E. Comply with "Glazing Manual" by Flat Glass Marketing Association except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.
- F. Inspect each piece of glass immediately before installation and eliminate any which have observable edge damage or face imperfections.
- G. Unify appearance of each series of lites by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.
- H. Cut and install colored (tinted) glass as recommended in "Technical Services Report No. 104" by PPG Industries.
- I. All expenses incurred by the Architect in troubleshooting the Security Glass and Glazing work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

3.3 PREPARATION FOR GLAZING

- A. Clean glazing channels and other framing members to receive security glazing, immediately before glazing. Remove coatings not firmly bonded to substrates. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
- B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

3.4 GLAZING

- A. Comply with glass, window, and frame manufacturer's recommendations.
- B. Install setting blocks, of proper size, at quarter points of sill rabbet. Set blocks in thin course of the heelbead compound, if any.
- C. Glazing shall be set with equal bearing for entire width.
- D. Provide spacers inside and out, and of proper size and spacing, for all glass sizes larger than 50 inches, except where gaskets are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- E. Voids and Filler Rods:
 - 1. Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on lite size, thickness, and type of glass, and complying with manufacturer's recommendations.
- F. Do not attempt to cut, seam, nip or abrade glazing which is tempered, heat strengthened, or coated.
- G. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- H. Provide silicone sealant bead along entire glazing perimeter, between glazing and stops (removable and non-removable), installed with a substantial "wash" away from the glass, providing a watertight seal from detergents and cleaning solutions.
- I. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.
- J. Specific recommendations for polycarbonate glazing installation:
 - 1. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner unless otherwise required. Set blocks in thin course of sealant.
 - 2. Provide spaces inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 inches, except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed tape thickness.
 - 3. Setting blocks, edge blocks, silicone cap beads, glazing tapes/filler rod installation shall comply with GANA (Glass Association of North America) 2008 Edition standards.
 - 4. Tapes and gaskets are to be installed slightly protruded so as to eliminate dirt and moisture pockets. Exposed sealants shall form a wash away from the glazing.
 - 5. Polycarbonate glazing edge engagements shall generally be 1 inch, unless otherwise approved by the Architect and confirmed by the manufacturer.
 - 6. Expansion allowances for polycarbonate shall generally be 1/16 inch per 12 inches, per 100 degrees F changes in temperature or as approved by the Architect per manufacturer's recommendations.
 - 7. Polycarbonate installation and fabrication shall comply with the written recommendations of the polycarbonate manufacturer. Copies of aforementioned recommendations shall be furnished to the Architect.

8. Install all polycarbonates as late as possible in the construction of the facility. Masking should be removed approximately 1 to 2 inches from the edges so as to allow the glazing tape/silicone to come in contact with the polycarbonate.
9. All polycarbonate lites, exposed to direct sunlight, shall have the masking entirely removed and then securely covered with polyethylene taped to the frames. Failure to remove the masking at this time may result in adhesion of the masking, preventing later removal.
10. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or by proven adhesive, including embedment of gasket tail in cured heel bead.
11. Glaze units at the building site.

K. Gasket Glazing:

1. Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in the glazing system.

3.5 CURE, PROTECTION AND CLEANING

- A. Cure glazing sealants & compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- B. Protect glass from breakage immediately upon installation, by attaching crossed streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass.
- C. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.
- D. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash off) to the deterioration of glazing materials and other work.
- E. Polycarbonate materials shall be cleaned using a mild detergent (such as Formula 409) and lukewarm water. Use a clean, soft cloth or sponge, rinse well with clean water.
- F. Paint splashes can be removed using VM&P Naphtha, isopropyl alcohol, or butyl cellosolve, or as otherwise recommended by the glazing. Do not use butyl cellosolve in direct sunlight.
- G. DO NOT use abrasives, paint scrapers, razor blades, or squeegees on polycarbonate. Benzene, gasoline, acetone, or carbon tetrachloride should not be used on either polycarbonate or mar resistant polycarbonate.
- H. Cleaning instruction coordination shall be the responsibility of the general contractor. The glazier manufacturer, painter, and other trades shall be informed of all cleaning instructions.
- I. Wash and polish glass on both faces not more than four (4) days before date scheduled for inspections that establish date of Substantial Completion. Comply with security glazing manufacturer's cleaning recommendations. These washing and polishing efforts shall be done by a professional cleaning/custodial firm.

END OF SECTION 111950

SECTION 111960 - SECURITY HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Detention Equipment Contractor (DEC):

1. Provide security hardware as indicated in the schedules and as specified herein.
2. Refer to Detention Door Schedule and door details; Custom/Security Hollow Metal Work Section 111910, and Security Control System Section 285000.
3. Coordinate Security Hardware installation with electrical requirements provided by the Electrical Contractor.
4. Make final electrical control hookups at door and control panels.
5. Coordinate all Security Hardware and electrical control needs required with other subcontractors and their equipment to have it function properly from the remote Security Control Consoles (e.g. overhead doors, architectural passage doors).
6. Furnish to the General Contractor any security hardware required for installation on Architectural Hollow Metal doors and frames. Provide necessary templates, etc. for installation.

B. General Contractor:

1. Coordinate installation of security hardware with DEC, Security Control System Contractor (SCSC) and Electrical Contractor.
2. Install on Architectural doors and frames any required security hardware being provided by the Security Control System Contractor (SCSC).

C. Electrical Contractor:

1. Coordinate electrical requirements with General Contractor, DEC and SCSC.
2. Provide all security control wiring, conduit, fittings, back boxes and junction boxes, as directed by Security Control System Subcontractor.
3. Provide all power wiring, conduit, fittings, and mortar boxes as required for equipment described within this section.

1.3 ACTION SUBMITTALS

- A. Required submittal for Security Hardware shall be submitted as a complete package. Failure to do so will result in the submittal being "Rejected" and returned.

B. Manufacturer's Data:

1. Submit one (1) reproducible (digital format) copy of product specifications, fabrication and installation instructions for each hardware item used.

C. Shop Drawings:

1. Shop drawings submittals for Security Hardware shall be submitted as an entire section.
2. Submit one (1) reproducible (digital format) copy of a horizontal hardware schedule, including all miscellaneous items. Give openings by door number and location,

- manufacturer's names, catalog numbers, keying information, materials, and finish in the scheduling sequence and format as recommended by security hardware manufacturer.
3. The Architect's approval of the hardware schedule will not relieve the Contractor or Supplier of responsibility for errors or omissions that it might contain.
 4. A Security Hardware Coordination Conference shall be held and coordinated by the General Contractor after the first Shop Drawing submittal of the Security Hardware. All participants should have at least one (1) week worth of review of this first Shop Drawing submittal and be prepared to comment on its appropriateness for their assigned job efforts.
 5. All security keying shall be reviewed with the Owner and approved during the Shop Drawing submittal review meeting.
- D. Samples and Templates:
1. Furnish to manufacturer of hollow metal doors and frames as required for proper reinforcement and preparation of their work.
 2. If required, the Hardware Supplier shall furnish physical hardware and backboxes to the door and frame manufacturer for inclusion into door and frame fabrications.
- E. Security Keying Chart/ Schedule:
1. Submit a Keying Chart schedule after both the Architect and Owner/User have approved the security keying shop drawings. Refer to articles titled "Cylinders, Keys, and Keying" and "Key Control" near the end of this Section.
- F. Maintenance Manual
1. Submit two (2) bound Maintenance and Repair Manuals, complete with detailed parts drawings, for all manual and energized security hardware products supplied in this section.
 2. Provide on-site review of these manuals and spare parts with the Owner's designated representative during training period. Refer to Article 1.6 "Training" ahead.
- G. Refer to Specification Section 111900 for additional submittal requirements.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Deliver all items in manufacturer's original packaging. Individually package and carefully mark each item for intended opening and use. Each item complete with all necessary screws, bolts, keys, instructions, and where necessary, installation templates.
 - B. Storage: Store items off floor in dry area of building out of way of other work in progress. Provide maximum protection against loss and damage.
 - C. Handling: Handle all items in a manner as to prevent damage.
- 1.5 GUARANTEE
- A. Upon Final Completion, the Manufacturer/Installer shall provide a written warranty covering the security hardware against defective materials and workmanship and guaranteeing satisfactory operation and performance for a period of one (1) year after Final Completion. The Manufacturer/Installer shall make necessary adjustments and replace any defective or broken parts caused by defective mechanical parts.
- 1.6 TRAINING
- A. Provide two (2) eight-hour days for training of Owner personnel for maintenance and repair of all security hardware. Training shall be at Owner's convenience prior to Final Completion.

- B. Training class and agenda shall include hands-on teaching of repair and maintenance. Contractor shall provide all equipment and tools necessary to conduct training for Owner's personnel.
- C. Training shall be conducted by employee of security hardware manufacturer or factory-authorized service representative with over five years of experience maintaining/repairing locks of the type installed in this facility.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Catalog numbers of the first manufacturer listed have been used to establish the quality required. Other manufacturers seeking approval shall do so in writing per General Requirements and shall list exact catalog numbers and description of the items he proposes to furnish:

ITEM			
1.	Hinges	Southern/Folger	Airteq Stanley
2.	Stops	Airteq	Northwest
3.	Holder, Surface Bolts	Glynn-Johnson	Yale
4.	Push, Pull	Southern/Folger	Airteq Brink
5.	Thresholds	Pemko	NGP Reese Zero
6.	Weatherstrip	Pemko	Reese Zero
7.	Security Locks	Southern/Folger	Airteq Brink

- B. Designations: Following abbreviations identify listed manufacturers:
 - 1. Southern/Folger Southern/Folger Co.; San Antonio, TX
 - 2. Airteq Cornerstone Detention; Montgomery AL
 - 3. Brink R.R. Brink Lock Systems, Inc.; Shorewood, IL
 - 4. Glynn-Johnson Glynn-Johnson Corp.; Chicago, IL
 - 5. Hager Hager Hinge Co.; St. Louis, MO
 - 6. Ives H. B. Ives Div.; New Haven, CT
 - 7. LCN LCN-Allegion
 - 8. NGP National Guard Products
 - 9. Northwest Northwest Specialty Hdw Inc.; Clackamas, OR
 - 10. Norton Norton Closer Div.; Charlotte, NC
 - 11. Pemko Pemko Mfg. Co.; Emeryville, CA
 - 12. Reese Reese Enterprises; Rosemount, MN
 - 13. Rockwood Rockwood Manufacturing Co.; Rockwood, PA
 - 14. Stanley Stanley Black & Decker; New Britain, CT
 - 15. Zero Zero Weatherstripping; Bronx, NY

2.2 MATERIALS

- A. Screws, Fasteners, and Tools:
 - 1. Provide exposed fasteners to match material/finish of item being fastened. Make fastener of the same metal as item fastened, except use plated brass or stainless steel for all aluminum items. Provide twenty (20) spares of each type of fastener used for anchoring hardware.
 - 2. Provide Torx-head (with center reject pin) security fasteners for exposed fasteners on all security hardware, regardless of manufacturer. Furnish six (6) tool holders and six (6) bits

for each different size screw. Holders and bits shall be left at the project after fastener installation and become the property of the user.

3. Provide two (2) alignment tools for medium security locks.

B. Hinges:

1. Heavy Duty, 4 1/2 FM – ICS:
 - a. Series/Manufacturer:
 - 1) 204 FMSS / Southern Steel Co.
 - 2) 604 FMCS / Airteq
 - 3) No.4 1/2"-ICS Prison / Brink
 - b. Description:
 - 1) 4 1/2 x 4 1/2, 3/16" thick leaves.
 - 2) Cast stainless steel leaves, non-removable stainless steel pins, stainless steel ball bearings, three knuckle with "HT" hospital tips.
 - 3) Provide with a 1/2" long steel stud on each leaf.
 - c. Provide quantities as follows:
 - 1) Doors less than 5 feet high - one pair.
 - 2) Doors over 5 feet to 7 feet 6 inches high - 1-1/2 pairs.
 - 3) Doors over 7 feet 6 inches high - 2 pair
 - 4) Doors 3 feet 6 inches wide and over - 2 pairs.
 - 5) Doors 4 feet 6 inches wide and over – 2-1/2 pairs.
2. Continuous Hinge (Plain Surface Type):
 - a. Series/Manufacturer:
 - 1) 4000 Series / Braun Mfg. Co., Inc. (www.hinge1.com)
 - 2) Approved Equal
 - b. Description:
 - 1) Hinge Leaf material - Cold Rolled Steel
 - 2) Hinge Pin material - Steel
 - 3) Shapes and lengths and gauges to be custom modified as required and/or as indicated on drawings.
 - 4) Provide quantities as indicated on the drawings and hardware sets.
 - 5) Provide USP primed.

C. Door Position Switches:

1. Swing Door Position Switch (Full-Mortise in frame head):
 - a. Series/Manufacturer:
 - 1) 240 CPS/Southern Steel
 - 2) 6200/Airteq
 - 3) 201020/Brink
 - b. Description:
 - 1) Provide a fully-mortised, door-position indication switch for monitoring the positions of a swinging door. Installed unit must be fully concealed when door is closed, and fit into the header of a standard, 2" high door frame. The track shall be self-concealing as the door is opened. Allow the door to swing a full 180 degrees. Provide a UL-listed, single-pole, double-throw type switch (SPDT), rated for 10 amps @ 125 or 250 VAC. Unit shall indicate "opened" when a 3'-0" wide door moves approximately 3/8" away from its stop. Provide a fine adjustment of the indication switch to compensate for

variations in field conditions. Design unit to operate mechanically for a minimum of two million cycles.

2. Magnetic Switch:
 - a. Series/Manufacturer:
 - 1) 200 MRS TB/Southern Steel Co.
 - 2) 6200/Airteq
 - 3) 201023/Brink
 - b. Mortise installation overhead mounting with switch contacts housed in the door frame and actuating magnet mortised into the top of the door.

D. Security Locks:

1. Maximum Security – Solenoid Operation:
 - a. Series/Manufacturer:
 - 1) 10120AE-2/Southern Steel Co.
 - 2) 9912S/Airteq
 - 3) 5026S x MCLH-M/Brink
 - b. Frame mounted 115 VAC, continuous duty solenoid actuated.
 - c. Bolt is retracted by an energized solenoid valve by a push-button at the control panel and remains retracted until door is opened.
 - d. Bolt is retracted manually by key from outside and inside or outside only.
 - e. Provide galvanized at exterior installations.
 - f. Provide interlock feature as required.
 - g. Internal switches monitor status of bolt.
 - h. Provide key cylinder extension where keyed both sides.
2. Maximum Security - Motor Operation:
 - a. Series/Manufacturer:
 - 1) 10120AM/Southern Steel Co.
 - 2) 9912M/Airteq
 - 3) 5026M x MCLH-M/Brink
 - b. Frame mounted 24 VDC, continuous duty motor actuated.
 - c. Bolt is retracted by energized motor by a push-button at control panel and remains retracted until door is opened.
 - d. Bolt is retracted manually by key from outside and inside or outside only.
 - e. Provide galvanized at exterior installations.
 - f. Provide interlock feature as required.
 - g. Internal switches monitor status of bolt.
 - h. Provide key cylinder extension where keyed both sides.
3. Medium Security - Motor Operation:
 - a. Series/Manufacturer:
 - 1) 10300M/Southern Steel Co.
 - 2) 9424/Airteq
 - 3) 3520-300 x ____/Brink
 - b. Security Grade: ASTM F 1577 Grade 1.
 - c. Frame mounted 24 VDC high torque gear motor.
 - d. Latchbolt retracts when motor is energized and remains retracted until the door is opened.
 - e. Mechanically unlocked by key outside and inside or outside only.

- f. Provide keeper with built-in limit switch; internal switches to monitor status of deadlock.
 - g. Provide interlock features as required.
 - h. Provide key cylinder extension where keyed both sides.
4. Maximum Security - Mechanical Operation:
- a. Series/Manufacturer:
 - 1) 1080A-2/Southern Steel Co.
 - 2) 5086-K2/Airteq
 - 3) 7086/Brink
 - b. Door mounted, deadbolt.
 - c. Lever tumbler, key outside and inside.
 - d. Supply with hollow metal lock mounting, escutcheons, and security screws.
 - e. Provide keeper with built-in limit switch where scheduled.
 - f. Provide 3/4-inch throw latchbolt
 - g. Provide galvanized at exterior/wet locations.
5. Maximum Security - Mechanical Operation:
- a. Series/Manufacturer:
 - 1) 1080A-1/Southern Steel Co.
 - 2) 5086-K1/Airteq
 - 3) 7082/Brink
 - b. Door mounted deadbolt.
 - c. Lever tumbler, key outside only.
 - d. Supply with hollow metal lock mounting, escutcheon, and security screws.
 - e. Provide keeper with built-in limit switch where scheduled.
 - f. Provide 3/4-inch throw latchbolt
 - g. Provide galvanized at exterior/wet locations.
6. Maximum Security - Mechanical Operation:
- a. Series/Manufacturer:
 - 1) 1070A-2/Southern Steel Co.
 - 2) 5076-K2/Airteq
 - 3) 7066/Brink
 - b. Door mounted, automatic spring deadbolting.
 - c. Lever tumbler, key outside and inside.
 - d. Supply with hollow metal lock mounting, escutcheons, and security screws.
 - e. Provide keeper with built-in limit switch.
 - f. Provide 3/4-inch throw latchbolt.
 - g. Provide galvanized at exterior/wet locations.
7. Maximum Security - Mechanical Operation:
- a. Series/Manufacturer:
 - 1) 1070A-1/Southern Steel Co.
 - 2) 5076-K1/Airteq
 - 3) 7062/Brink
 - b. Door mounted, automatic spring deadbolting.
 - c. Lever tumbler, key outside.
 - d. Supply with hollow metal lock mounting, escutcheons, and security screws.

- e. Provide keeper with built-in limit switch.
 - f. Provide 3/4-inch throw latchbolt.
 - g. Provide galvanized at exterior/wet locations.
8. Medium Security - Mechanical Operation: Food Pass Lock
- a. Series/Manufacturer:
 - 1) 1017AM/Southern Steel Co.
 - 2) 5017M/Airteq
 - 3) 7017M/Brink
 - b. Keyed outside only.
 - c. Reverse bolt bevel at food pass locations. Refer to details on Drawings.
9. Medium Security - Mechanical Operation: Paper Pass Lock
- a. Series/Manufacturer:
 - 1) 1017AM/Southern Steel Co.
 - 2) 5017M/Airteq
 - 3) 9025/Brink
 - b. Keyed outside only.
 - c. Refer to details on Drawings
- E. **Closers: (Recess Mounted)**
- 1. Series/Manufacturers:
 - a. 2210 Series /LCN
 - b. 7970 Series /Norton
 - 2. Description:
 - a. Provide recessed door head closers unless noted otherwise.
 - b. All door closers shall be by one manufacturer and carry a fifteen (15) year warranty, except electrical components, which will carry a two-year warranty. All door closers shall be inspected, after installation, by a factory representative to insure their proper adjustments and operations.
 - c. Spring power shall be adjustable. Spring power shall provide an opening force range of 8 to 15 pounds from 0 degrees to 90 degrees.
 - d. Closers shall have separate adjustments for latch speed, general speed, and back check.
 - e. Provide accessories required to insure a proper installation.
- F. **Pull Loop:**
- 1. Series/Manufacturers:
 - a. 212-C/Southern Steel Co.
 - b. 612/Airteq
 - c. 300021/Brink
 - 2. Stainless steel. Overall length 8-3/4" x 1-1/2" clearance. Fasteners shall be 2-3/8" - 6 x 3/4" stainless steel Torx-head security screws with center reject pin.
- G. **Pull Flush:**
- 1. Series/Manufacturer:
 - a. 214-S/Southern Steel Co.
 - b. 614/Airteq
 - c. 300011/Brink
 - 2. Stainless steel, 4" wide, 1/8" thick x 5" high. Fasteners shall be 1/4" 20 x 5/16" stainless steel Torx-head security screws with center reject pin.

H. Push/Pull Plate:

1. Series/Manufacturer:
 - a. 120L/Hager
 - b. 1456/Hiawatha
 - c. 91-RKW/Rockwood
2. 1/8" thick stainless steel, 3.5" w x 16" h with 7/8" lip projection at bottom. Attach with stainless steel Torx-head security screws with center reject pin.

I. Door Stops:

1. Series/Manufacturer:
 - a. 650/Airteq (wall or floor)
 - b. 606S/Northwest (wall or floor)
 - c. 3001/ Stanley (floor); 3002/ Stanley (wall)
 - d. 467/Rockwood (wall or floor)
2. Silicone rubber body, 2" diameter. 2-1/2" (3-1/2") high.
3. 5/8" x 2-1/2" diameter mounting shank.
4. Embedded in wall or floor with epoxy resin adhesive.

J. Thresholds: (refer to Security Hardware Sets for location)

1. Series/Manufacturer:
 - a. 271A - 5" x 1/4"/Pemko
 - b. S405A - 5" x 1/4"/Reese
 - c. 545 - 5" x 1/4"/Zero
2. Set the aluminum threshold into a full bedding of mastic and secured with stainless steel **Torx-head** security screws with center reject pin.
3. Threshold shall be ADA compliant.

K. Thresholds: (Typical & Anti-Pass)

1. Series/Manufacturer:
 - a. 950/NGP
 - b. 2010_PK/ Pemko
 - c. S257/ Reese
 - d. 566/ Zero
2. Provide anti-pass thresholds as indicated in the Detention Door Schedule.
3. Provide aluminum mill finish, unless noted otherwise.
4. Set the aluminum threshold into a full bedding of mastic and secured with stainless steel Torx-head security screws with center reject pin.
5. Threshold shall be ADA compliant.
6. Threshold shall prevent the passing of paper or other contraband under the door.

L. Weatherstripping/Sound Seals:

1. Series/Manufacturer:
 - a. 305CR x 315CN/Pemko
 - b. DS70C x 362/Reese
 - c. 50 x 339 (modified to receive a sweep)/Zero
2. Extruded anodized aluminum with neoprene seal, secured with stainless steel Torx-head security screws with center reject pin.

M. Weatherstripping/Sound Seals (Bulb type):

1. Series/Manufacturer:
 - a. S88/Pemko
 - b. 5050/NGP

- c. 188S/Zero
- 2. Self-adhesive silicone rubber perimeter seal.
- N. **Door Bottom Sweep:**
 - 1. Series/Manufacturer:
 - a. 345A (9/16" projection x 1-1/2" H)/Pemko
 - b. R199/Reese
 - c. 17/NGP
 - d. 11/Zero
 - 2. Extruded anodized aluminum, secured with stainless steel Torx-head security screws with center reject pin.
- O. **Rain Drip:**
 - 1. Series/Manufacturer:
 - a. 346C (2-1/2" projection)/Pemko
 - b. R201/Reese
 - c. 16/NGP
 - d. 142A/Zero
- P. **Automatic Door Bottom:**
 - 1. Series/Manufacturer:
 - a. 420ASL/Pemko
 - b. 372/Reese
 - c. 360/Zero
 - 2. Mortised type, cam-actuated drop down silicone seal, with spring mechanism return.
- Q. **Kickplates:**
 - 1. Series/Manufacturer:
 - a. 194S/Hager
 - b. K1050/Rockwood
 - 2. Kickplates shall be 0.050" stainless steel with eased edges. 10" high (except reduce height 1/2" less than bottom rail when required) x 2" less than door width on singles and 1" less on pairs. Fasteners shall be full threaded, oval, undercut, metal screw; Torx-head security screws with center reject pin.
- R. **Door Silencers:**
 - 1. Series/Manufacturer:
 - a. GJ-64/Glynn-Johnson
 - b. 608/Rockwood
 - c. SR64/Ives
 - 2. Provide three (3) silencers per door. Silencer design forms an air pocket to absorb shock and reduce noise of door closing. Once installed, the silencers should be tamper-proof and eliminate door rattle.
- S. Security Hardware Finishes:

	<u>U.S. Symbol</u>	<u>ANSI Symbol</u>	<u>Description</u>
1. Hinges, Exterior	US32D	630	Satin Stainless Steel
2. Hinges, Interior	US32D	630	Satin Stainless Steel
3. Locks and Pulls	US26D	626	Satin Chromium
4. Closers	AL	689	Aluminum Painted
5. Push, Kick	US32D	630	Satin Stainless Steel
6. Door Pulls	US32D	630	Satin Stainless Steel

7. Escutcheons US32D 630 Satin Stainless Steel

2.3 CYLINDERS, KEYS, AND KEYING

- A. The security locks will incorporate three (3) keying systems, one for pin tumbler (mogul cylinder) locks, one for lever tumbler (paracentric) locks, and one for builder's hardware high security six-pin tumbler cylinder locks. Dye stamp each keying system's keys for identification, corresponding to the final/approved Keying Chart.
1. Review all security keying with Owner for final approval during submittal phase.
 2. Provide ASSA mortise and Mogul cylinders for detention locks.
 3. Provide a system of keys and matching locks that are color-coded and marked for identification by touch to comply with "sight and touch" requirements in 2018 North Carolina Fire Prevention Code section 403.8.3.4 and 10A NCAC 14J .0405.
 4. Key Food Pass locks alike and provide ten (10) keys with dye stamp identification marking.
 5. Key Paper Pass locks alike & provide ten (10) keys with dye stamp identification marking.
 6. Master key mogul cylinder locks as indicated in Detention Door Schedule and as confirmed with the Owner during the Security Keying Meeting.
 7. Provide two (2) keys in each Key Cabinet for all individual key designations.
 8. Provide three (3) keys in each Key Cabinet for each Master key designation.
 9. Provide a complete, detailed, schematic Keying Chart of the Security Keying System's individual key designations.
 - a. Two (2) copies of this Keying Chart, overlaid on an architectural floor plan print, shall be turned over to the Owner/User at the completion of the project. The cost for Keying Chart shall be included with the cost of materials at the time of bidding.
- B. Key Control:
1. Provide one (1) Key Cabinet in [Central Control CR205](#). Coordinate exact location with Owner and other equipment to be wall-mounted in the control room.
 2. Key Cabinet (wall mounted, surface):
 - a. Key Control system shall be furnished with a capacity of 1.75 times the number of individual key designations and shall be a complete dual tag system.
 - b. Key Cabinet shall have concealed-type hinge and rounded sides.
 - c. Panels must have individual hooks and label pockets formed as an integral part of the panel, for each key type, as required. (i.e. paracentric, P-_; mogul, M-_; builders hardware, B-_).
 - d. Key Tags of two (2) types shall be provided, one tag to attach to the individual key designations that permanently stays in the key cabinet and one tag to attach to the individual key designation that is loaned out.
 - e. Indexing shall be provided to record information concerning locks and keys alphabetically.
 - f. Permanent Loan Registry shall be furnished to protect identity of key borrowers while Receipt Tabs shall be supplied for temporary loan.
 3. Keys shall not leave the manufacturer's custody without prior arrangements for delivery and authorization from the Owner.

2.4 SECURITY HARDWARE SETS FOR SECURITY/DETENTION DOORS

- A. Provide security hardware equal to items scheduled. Verify electrical devices are appropriate for models indicated. Electrical control connections are included in work of Section 285000 "Security Control System."

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1. Smoke seals and automatic door bottoms shall be added to all doors in smoke barriers as required to meet smoke and fire ratings per UL 1784.
2. **Food Pass**
 - a. All doors indicated with food passes in the Options column of the Detention Door Schedule shall have the following additional hardware:
 - 1 Braun Hinge – 4807-E
 - 1 Food Pass Lock, Southern Steel 1017AM

B. Security Hardware Sets Schedule:

HARDWARE SET NO	QUANTITY	CLASS	DESCRIPTION
SH1	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AE x K2 x KCE
	2	Loop Pulls	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010_PK
	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH1A	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AE x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010_PK
	1	Door Stop	Airteq #650
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH1B	3 or 4	Hinges	SS 204FMSS

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	1	Lock	SS 10120AE x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 271A
	1	Door Stop	Airteq #650
	1	Auto Bottom	Pemko 420ASL
SH2	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH2A	3 or 4	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq # 650
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
SH3	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K1

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	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq # 650
	3	Silencers	
SH4	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K2 x KCE, Provide no mechanical latch hold back function
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
	1	Jamb-mounted Push Button (for local lock operation)	Airteq # 6300 (mount inside Control Room)
SH5	3	Hinges	SS 204FMSS
	1	Lock	SS 10120AM x K1
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
SH6	1	Corridor Sliding Device	SS 3165LX.bPKM-2 (Emergency Manual Key Release, electric keyswitch Mogul K2)
	1	Loop Pull	SS 212C

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	1	Flush Pull	SS 214S
	1	Weatherstrip	Pemko 332CR
	1	Door Skirt	
SH6A	1	Corridor Sliding Device	SS 3165LX.bPKM-2 (Emergency Manual Key Release, electric keyswitch Mogul K2)
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Emergency Pushbutton	Airteq #6300 (each side)
	1	Weatherstrip	Pemko 332CR
	1	Weatherstrip (Door Sweep)	Pemko 18061 CNB
		<u>Emergency Pushbutton shall only close door after door is activated by the Emergency Release function specified in Section 285020 Pushbutton shall not otherwise be active</u>	
SH7	3	Hinges	SS 204FMSS
	1	Lock	SS 10300M x K2 x KCE
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
SH7A	3	Hinges	SS 204FMSS
	1	Lock	SS 10300M x K2 x KCE
	2	Loop Pull	SS 212C
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB

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	1	Door Stop	Airteq #650
	1	Kickplate	
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko S88
	1	Jamb-mounted Push Button (for local lock operation)	Airteq # 6300 (mount inside room)
SH8	3	Hinges	SS 204FMSS
	1	Lock	SS 10300M x K1
	1	Loop Pull	SS 212C
	1	Flush Pull	SS 214S
	1	Door Closer	LCN 2210
	1	Door Position Switch	SS 200MRS TB
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR
	1	Door Stop	Airteq #650
SH9	3	Hinges	SS 204FMSS
	1	Lock	SS 1080A x K2
	1	Keeper	SS 470CL
	2	Loop Pull	SS 212C
	1	Door Position Switch	SS 200MRS TB
	1	Door Bottom Sweep/Rain Drip	Pemko 345A
	1	Threshold	Pemko 2010_PK
	1	Auto Bottom	Pemko 420ASL
	1	Weatherstrip	Pemko 305CR x 315CN
	1	Door Stop	Airteq No.650
	1	Escutcheon	SS 218
	1	Cylinder Shield	SS 219
SH11		(NOT USED)	
SH12	1	Lock	SS 1050D Gate Lock x K2

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	1	Gate Position Switch	GE 2707A
	1	Self-closing Hinge	Coordinate with gate supplier
SH13 (Roof Hatch)	1	Lock	SS 1080A x K2

C. Security Spare Locks and Lock Parts:

1. Provide the following for the Owner's stock:
 - a. 1 Lock 10120AM
 - b. 1 Lock 10300M
 - c. 2 Mogul Cylinders
 - d. 2 Builders Cylinders
2. One each repair parts kit for each lock series, containing springs, micro switches, screws, nuts and washers.
3. One parts kit containing an assortment (minimum 25) of all hardware security screws used on this project.
4. One complete set of hardware security screwdrivers for all sizes of hardware security screws used on this project.
5. One repair parts list and assembly drawings bound in a manual for all security products supplied in this section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors, frames and hardware for damage, defects, and suitability for intended use. Restore all parts or items found damaged, defective, or inadequate, or replace with good material before installation.

3.2 INSTALLATION

A. Mounting Heights:

1. Heights given are centerline heights up from finish floor unless noted otherwise; heights given "Number to Number" indicate that all shall be at one consistent height within limits given. Where heights of items are not listed, mount per recommendations of DHI.
 - a. Bottom hinge 10 to 13 inches
 - b. Top hinge 6 to 8 inches down from head
 - c. Intermediate hinges Equally spaced
 - d. Door knobs 36 to 40 5/16 inches
 - e. Door pull 42 to 48 inches
 - f. Deadlocks 54 inches floor to centerline

- B. Fitting:
 - 1. Fit all hardware accurately and properly.
 - 2. Remove exposed parts until after painting is completed. Then reinstall.
 - 3. Securely fasten all fixed parts.
 - 4. Fit faces of mortised parts snug and flush.
 - 5. Ensure operating parts move freely and smoothly without binding, sticking, or excessive clearances.

- C. Adjusting and Finishing:
 - 1. After work has been otherwise completed, examine all hardware for complete and proper installation.
 - 2. Lubricate bearing surfaces of moving parts
 - 3. Adjust latching and holding devices to proper function
 - 4. Adjust door closer devices for proper speed and power.
 - 5. Test keys for conformance to approved Keying Chart system.
 - 6. Clean all exposed surfaces, check for surface damage and then polish.

- D. Thresholds:
 - 1. Install in one continuous piece, full width of opening. Set in full bed of sealant and fasten with countersunk anchors at 6 inches on center with Torx-head security screws with center reject pin.

3.3 DEFECTIVE WORK

- A. Where hardware is found defective in materials or installation; rework, restore, replace, or otherwise correct as directed.

- B. The following will be considered as defective materials:
 - 1. Unauthorized substitutions.
 - 2. Items delivered with missing, broken, damaged or defaced parts.
 - 3. Items of incorrect hand or function.

- C. The following will be considered as defective installation:
 - 1. Items broken, damaged, or defaced after delivery.
 - 2. Items incomplete, misaligned or incorrectly located.

- D. All expenses incurred by the Architect in troubleshooting the Security Hardware Work, caused by inadequate workmanship or other form of non-performance on the part of the subcontractor, shall be borne by that subcontractor.

END OF SECTION 111960

SECTION 114000 – FOOD SERVICE EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the contract including general and supplementary conditions and general requirements apply to the work specified in this section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Plumbing: Refer to Division 22, including:
 - 1. Rough-in piping for gas and water supply and waste lines.
 - 2. Piping for supply and waste lines.
 - 3. Traps, grease traps, line strainers, tail pieces, valves, stops, shut offs and miscellaneous fittings required for complete installation.
 - 4. Final connections.
 - 5. Indirect drains for sink compartments.
- B. Mechanical: Refer to Division 23, including:
 - 1. Roof mounted fans and connecting ductwork not shown as part of the kitchen equipment.
 - 2. Final connections, including approved welded duct connections to hoods.
- C. Electrical: Refer to Division 26, including:
 - 1. Rough-in conduit, wiring, line and disconnect switches, safety cut-offs and fittings, control panels, fuses, boxes, and fittings required for complete installation.
 - 2. Final connections, including mounting and wiring of switches furnished as part of the food service equipment (unless otherwise indicated on the drawings).
- D. Mechanical Work:
 - 1. Provide exhaust hoods with connection collars ready for final connection by HVAC Section.
 - 2. Provide stainless steel exposed ducts to ceiling for dishmachine.

1.3 WORK INCLUDED THIS SECTION:

- A. Furnish and install all food service equipment as specified herein, including that which is reasonably inferred, with all related items necessary to complete work shown on contract drawings and/or required by these specifications.
- B. Electrical Work:

1. Interwiring of food service equipment between components within equipment, such as heating elements, switches, thermostats, motors, etc., complete with junction box as is applicable, ready for final connection.
2. Voltages shall be as indicated on contract drawings. Any differences in electrical characteristics at job site from those shown on contract documents must be submitted to Architect for consideration prior to ordering equipment.

C. Plumbing Work:

1. Furnish all equipment with faucets, sink waste assemblies, and trim as specified in this section.
2. Other than sink compartments, extend all indirect waste lines to nearest floor receptor. All such drain lines to be properly sized. Drain shall terminate with proper air gap above flood rim of floor receptor. Drain lines to be copper with silver paint unless specified otherwise. Drain lines in public areas to be chrome plated where exposed to public view.

D. Mechanical Work:

1. Provide exhaust hoods with connection collars ready for final connection by Division 23.

1.4 QUALITY ASSURANCE

- A. It is required that all custom fabricated equipment such as food serving units, tables, sinks, counter tops, etc., be manufactured by a food service equipment fabricator who has the plant, personnel and engineering equipment required. Such manufacturer shall be subject to approval of Architect. All work in the above category shall be manufactured by one manufacturer and shall be of uniform design and finish.
- B. Manufacturer of this equipment must be able to show that they are now and for the past five years have been engaged in manufacture or distribution of equipment, as required under this contract, as their principal product.
- C. Manufacturer of equipment herein specified shall be a recognized distributor for items of equipment specified herein which are of other manufacture than their own.
- D. Only manufacturers who can meet the foregoing qualifications will be acceptable.
- E. All work shall be done in an approved professional manner, to the complete satisfaction of the Owner.

1.5 SUBMITTALS

- A. Submit shop drawings as required by General Conditions. All shop drawings and rough-in drawings shall be CAD drafted and must be submitted in .DWF or .PDF electronic format. Multiple hard copies are not acceptable.
- B. Shop drawings and bound brochures covering manufactured or "buy-out" items covering all work and equipment included in this contract shall be submitted to Architect as soon as possible after award of contract. After approval, Food Service Equipment Contractor shall furnish to

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Architect electronic files of shop drawings and brochures, corrected as required by virtue of review comments, for distribution to various interested trades on project. All costs of reproduction and submission shall be part of the contract.

Bound brochures and cut sheet submittals must be copied to Owner for review and comment.

- C. Provide fully dimensioned rough-in plans at 1/4" scale, consisting of a separate drawing for each discipline. Each drawing shall show equipment shaded down 50%. Rough-in set shall include all required mechanical, electrical, plumbing, services for equipment and dimensioned rough-in location for same. Rough-in locations shown shall make allowances for required traps, switches, etc., thereby not requiring interpretation or adjustment on the part of other Contractors. Food Service Equipment Contractor shall visit site to verify all rough-in and sleeve locations prior to installation of finished floors and shall cooperate with other Contractors involved in proper location of same. Food Service Equipment Contractor shall be responsible for any required relocations of rough-in due to errors or inaccuracies on those rough-in plans which they prepare.
- D. Rough-in plans shall include all required services which relate to equipment, but which may not directly connect thereto, such as convenience outlets at walls, hose stations, floor drains, etc.
- E. Rough-in plans shall also include all required outlet services for equipment which is designated on the drawing schedule, even though such equipment may not be included in this contract. Drawings shall indicate dimensions for floor depressions, wall openings, etc., for equipment.
- F. Fully dimensioned and detailed shop drawings of custom fabricated equipment items shall be submitted, drawn at 3/4" and 1 - 1/2" scale for plans, elevations, and sections respectively. Drawings shall show all details of construction, installation, and relation to adjoining and related work where cutting or close fitting is required. Drawings shall show all reinforcements, anchorage, and other work required for complete installation of all fixtures.
- G. Do not begin fabrication of custom manufactured equipment until approvals of shop drawings have been received and until field measurements have been taken by Food Service Equipment Contractor, where such measurements are necessary to assure proper conformance with intent of contract drawings and specifications.
- H. Make field measurements, giving due consideration to any architectural, mechanical, or structural discrepancies which may occur during construction of building. No extra compensation will be allowed for any difference between actual measurements secured at job site and dimensions indicated on contract drawings. Any differences which may be found at job site during field measurements shall be submitted to Architect for consideration before proceeding with fabrication of equipment.
- I. Submit illustrative brochures for manufactured or "buy-out" equipment items, complete with illustrations, specifications, line drawings, rough-in requirements, and list of accessories or other specified additional requirements. Brochures shall be bound and shall include data on all equipment which is to be provided, arranged in numerical sequence which conforms to item numbers of specifications. Omission of data does not reduce obligation to provide items as specified.
- J. Approval of shop schedules and brochures will be in general and shall be understood to mean that Architect has no objection to use of materials or processes shown. Approval does not relieve Food

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Service Equipment Contractor from responsibility for errors, omissions, or deviations from their contract requirements.

1.6 SUBSTITUTIONS - STANDARDS

- A. Refer to Instructions to Bidders and Division 01 for requirements.
- B. All unspecified substitutions after bid must be submitted to Owner for written approval prior to acceptance.

1.7 DRAWINGS

- A. Drawings which constitute part of contract documents indicate general arrangement of piping and location of equipment. Should it be necessary to deviate from the arrangement indicated to meet structural conditions, make such deviations without expense to Owner.
- B. Specifications and drawings are reasonably exact, but their extreme accuracy is not guaranteed. Drawings and specifications are for assistance and guidance of Contractor, and exact locations, distances and levels shall be governed by the building.

1.8 MANUFACTURER'S DIRECTIONS

- A. Follow manufacturer's directions in all cases where manufacturers of articles used in this contract furnish directions or prints covering points not shown on drawings or specifications.

1.9 INDUSTRY STANDARDS

- A. Electric operated and/or heated equipment, fabricated or otherwise, shall conform to latest standards of National Electric Manufacturers Association and of Underwriters Laboratories, Inc., and shall bear the U.L. label.
- B. Cooking and hot food holding equipment shall meet minimum construction standards as noted by NSF #4.
- C. Refrigeration equipment shall meet minimum construction standards as noted by NSF #7.
- D. Items of food service equipment furnished shall bear the N.S.F. seal.
- E. Food service equipment shall be installed in accord with N.S.F. standards.
- F. Work and materials shall comply with requirements of applicable codes, ordinances, and regulations, including but not limited to those of Occupational Safety and Health Act (OSHA), National Fire Protection Association, State Fire Marshal, State Accident Commission, U.S. Public Health Service, State Board of Health, local health codes, etc.
- G. No extra charge will be paid for furnishing items required by regulations, even though such may not be shown on drawings or called for in these specifications.
- H. Rulings and interpretations of enforcing agencies shall be considered part of regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURED EQUIPMENT

- A. All like types of equipment such as all refrigerated and heated cabinets, all ovens, and all mixers shall be by the same manufacturer.
- B. Except as may be specified otherwise under individual item specifications in "Equipment Schedule", all items of standard manufactured equipment shall be complete in accord with manufacturer's standard specification for specific unit or model called for, including finishes, components, attachments, appurtenances, etc., except as follows:
 - 1. All items of standard equipment shall be that manufacturer's latest model at time of delivery.
 - 2. Substitutions for manufactured equipment specified will be accorded consideration under terms set forth in "Substitutions - Standards".

2.2 FABRICATED EQUIPMENT

- A. Stainless steel shall be U.S. standard gauges as called for, 18-8, Type 302, Type 304, No. 4 finish.
- B. Galvanized iron shall be Armco or equal. Framework of galvanized iron shall be welded construction, having welds smooth, and where galvanizing has been burned off, touched up with high grade aluminum bronze.
- C. Legs and crossrails shall be continuously welded, unless otherwise noted, and ground smooth.
- D. Bottom of legs at floor shall be fitted with sanitary stainless-steel bullet type foot, with not less than 2" adjustment.
- E. Legs shall be fastened to equipment as follows:
 - 1. To sinks by means of closed gussets. Gussets shall be stainless steel, reinforced with bushing, having set screws for securing legs.
 - 2. To tables and drainboards with closed gussets which shall be welded to stainless steel hat sections or channels, 14 gauge or heavier, exposed hat sections having closed ends. Bracing shall be welded to underside of tops.
- F. Closed gussets shall be a 3" minimum diameter at top, continuously welded to frame members or to sink bottom.
- G. Sinks, unless otherwise specified, shall be furnished with rotary type waste outlets, without connected overflows: Atlantic Brass Works Model 772-RB; Fisher Brass Foundry Model 250A; T&S; or approved equal. Where exposed, furnish wastes chromium plated.
- H. Rolls shall be 1 1/2" diameter, except as detailed contrary, with corners bullnosed, ground and polished.

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- I. Seams and joints shall be shop welded. Welds to be ground smooth and polished to match original finish. Materials 18 gauge or heavier shall be welded.
- J. Metal tops shall be one-piece welded construction, unless specified otherwise, reinforced on underside with stainless steel hat sections or channels welded in place. Crossbracing to be not more than 30" on centers.
- K. Drawers to be 18-gauge stainless steel channel type housing and drawer cradle, both housing and cradle being reinforced and welded at corners, housing being secured to underside of table top, and both housing and cradle being sized for and fitted with 18-gauge 20" x 20" x 5" deep stainless-steel drawer insert having coved corners. Drawer insert shall be easily removable from cradle without tools or having to remove entire drawer. Drawers to have stainless steel fronts. Provide with recessed flush type stainless steel pulls.
- L. Support drawer on fabricated 14-gauge stainless steel interlocking channel solid delrin ball bearing wheels. Support slides shall be load rated at 200 lb. per pair. Slides to be Component Hardware S52 Series.
- M. Enclosed cabinet type bases shall be made of formed steel sheets reinforced with formed steel sections to create a rigid structure. Steel shall be 18-gauge or heavier. Base shall be welded construction throughout with front rails, mullions, etc., welded to appear as one-piece construction. All exposed sections of interior and exterior shall be stainless steel, and unexposed sections shall be galvanized steel, unless specified contrary.
- N. Hardware shall be solid materials and except where unexposed or specified contrary, of cast brass, chrome plated. Stampings are not acceptable. Identify all hardware with manufacturer's name and number so that broken or worn parts may be ordered and replaced.
- O. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- P. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- Q. Fabricate sink compartments with fully coved vertical and horizontal corners. Multiple compartment partition to be double thickness, continuously welded where sheets join at top. Front of multiple compartment sinks to be continuous on exterior. Bottoms shall be creased to drain.
- R. Ends of all fixtures, splashbacks, shelves, etc., shall be finished flush to walls or adjoining fixtures.
- S. Dishtables, draitables, splashbacks and turned-up edges shall have radius bends in all horizontal and vertical corners, coved at intersections.
- T. Rounded and coved corners or radius bends shall be 1/2" radius or longer.
- U. Shelves in fixtures with enclosed bases shall be turned up on back and sides and feathered slightly to ensure tight fit to enclosure panels. Bottom shelves shall be made for easy removal unless otherwise noted.

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V. Undersides of tops to be coated with heavy-bodied resinous material compounded for permanent, non-flaking adhesion to metal, 1/8" thick, applied after reinforcing members have been installed, drying without dirt-catching crevices.

W. Metal components, unless specified or noted otherwise, to be the following gauges:

Counter and table tops	14 ga.	Stainless Steel
Wall shelves	16 ga.	Stainless Steel
Pipe leg undershelves	16 ga.	Stainless Steel
Drawer fronts	16 ga.	Stainless Steel
Enclosed cabinet bases	18 ga.	Stainless Steel
Sinks and drainboards	14 ga.	Stainless Steel
Exhaust hoods	18 ga.	Stainless Steel
Legs 1 - 5/8" diameter	16 ga.	Stainless Steel
Doors (outer pan)	18 ga.	Stainless Steel
Doors (inner pan)	20 ga.	Stainless Steel

X. Products fabricated by Savannah Industrial Solutions, John Boos, Premier Stainless, Eagle Group, Advance Tabco, or approved equal, modified to comply with specifications, are acceptable.

2.3 HEATING EQUIPMENT

A. Wherever electric heating equipment or thermostat control for such equipment is specified, it shall be complete, and of the materials, size and rating specified within equipment item or details. All such equipment shall be designed and installed to be easily cleaned or to be easily removed for cleaning.

B. Electrical appliances or heating element circuits of 120 volts shall not exceed 1650 watts, unless specifically shown contrary.

2.4 SWITCHES AND CONTROLS

A. Food Service Equipment Contractor shall supply on each motor driven appliance or electrical heating unit suitable control switch of proper type in accord with Underwriter's Code.

B. All internal wiring for fabricated equipment items included, all electrical devices, wiring, controls, switches, etc., built into or forming an integral part of these items shall be furnished and installed by Food Service Equipment Contractor in their factory or building site with all items complete to junction box for final connection to building lines by Electrical Contractor.

C. Provide standard 3-prong plugs to fit "U" slot grounding type receptacles, similar to No. 5262, for all equipment items powered by plugging into 110-120 volts, single phase AC. Also, provide suitable length 3-wire cord for equipment.

2.5 CONNECTION TERMINALS

A. All equipment shall be complete with connection terminals as standardized by equipment manufacturers, except where specified otherwise.

2.6 LOCKS

- A. Fit all doors for reach-in refrigerated compartments with locking type latches. Provide master keys.

2.7 GAS EQUIPMENT

- A. Equipment to be suitable for use with gas available at site, and to be furnished by F.S.E.C. with pressure regulators designed to work with incoming pressure.

2.8 GAS QUICK DISCONNECTS

- A. Where specified, gas quick disconnects shall be furnished complete with gas valve, gas connector hose, quick disconnect fitting elbows, and restraining cable, all AGA approved. Gas hose shall be flexible, braided or corrugated stainless steel with smooth plastic exterior coating or sleeve of heat shrink tubing (provide on all caster mounted gas equipment).
- B. All mobile cooking equipment requiring surface protection by fire suppression nozzles shall be secured in place by stainless steel cradle type wheel stops as manufactured by the Eagle Group or Select Stainless products. Plastic wheel stops are not acceptable.

2.9 LAMINATED PLASTIC

- A. Wherever laminated plastic materials are specified, they shall be Formica, Wilson-Art, Micarta, or approved equal. Veneer all materials using urea base cement, waterproof and heatproof. Rubber base adhesives are not acceptable. Apply materials directly over close-grained plywood such as mahogany or birch. Standard fir plywood is not acceptable. Face exposed surfaces and edges with 1/16" material and corresponding back faces with 1/32" reject material. Place top sheet on and over finished edge.

PART 3 - EXECUTION

3.1 GENERAL

- A. Work under this contract and covered under this section of specifications includes but is not limited to:
 - 1. Cutting of holes and/or ferrules on equipment for piping, drains, electrical outlets, conduits, etc. as required to coordinate installation of food service equipment with work of other Contractors on project.
 - 2. Field checking of building and rough-in requirements, and submission of brochures and shop drawings, all as required hereinbefore under "Submittals".
 - 3. Repair of all damage to premises as result of this installation, and removal of all debris left by those engaged in this installation.
 - 4. Having all food service equipment fixtures completely cleaned and ready for operation when building is turned over to Owner.

3.2 INSTALLATION PROCEDURES

- A. Food Service Equipment Contractor shall make arrangements for receiving their custom fabricated and "buy out" equipment and shall make delivery into building as requisitioned by their installation superintendent. They shall not consign any of their equipment to the Owner or to any other Contractor unless they have written acceptance from them and have made satisfactory arrangements for the payment of all freight and handling charges.
- B. Food Service Equipment Contractor shall deliver all their custom fabricated and "buy out" equipment temporarily in its final location, permitting Trades to make necessary arrangements for connection of service lines; they shall then move equipment sufficiently to permit installation of service lines, after which they shall realign their equipment level and plumb, making final erection as shown on contract drawings.
- C. All portable or counter mounted equipment weighing more than 25 pounds shall be mounted on 4" stainless steel adjustable legs.
- D. This Contractor shall coordinate their work and cooperate with other trades working at site toward the orderly progress of the project.
- E. Architect or Owner's Agent shall always have access to plant or shop in which custom fabricated equipment is being manufactured, from time contract is let until equipment is shipped, in order that progress of work can be checked, as well as any technical problem which may arise in coordination of equipment with building. Any approval given at this point of manufacture shall be tentative, subject to final inspection and test after complete installation.
- F. Food Service Equipment Contractor shall assist Architect, Owner, and/or Owner's Agent in making any desired tests during or prior to final inspection of equipment; they shall remove immediately any work or equipment rejected by Architect, Owner, and/or Owner's Agent, replacing same with work conforming with contract requirements, and shall reimburse mechanical and/or other contractors involved for extra work made necessary by such replacement.
- G. This Contractor shall keep premises free from accumulation of their waste material and rubbish, and at completion of their work shall remove their rubbish and implements, leaving areas of their work broom clean.
- H. This Contractor shall provide and maintain coverings or other approved protection for finished surfaces and other parts of their equipment subject to damage during and after erection. After removal of protective coverings, all field joints shall be grounded, polished and entire work shall be thoroughly cleaned and polished.

3.3 TRIMMING AND SEALING EQUIPMENT

- A. Seal completely spaces between all units to walls, ceilings, floors, and adjoining (not portable) units with enclosed bodies against entrance of food particles or vermin by means of trim strips, welding, soldering, or commercial joint material best suited to nature of equipment and adjoining surface material.

- B. Close ends of all hollow sections.
- C. Equipment butting against walls, ceilings, floor surfaces and corners to fit tightly against same; backsplashes or risers which fit against wall to be neatly scribed and sealed to wall with Dow Corning # 732 RTV or General Electric clear silicone sealant, wiping excess sealant out of joint to fillet radius. Where required to prevent shifting of equipment and breaking wall seal, anchor item to floor or wall.
- D. Treat enclosed spaces (inaccessible after equipment installation) for vermin prevention in accord with industry practice.

3.4 TESTING AND DEMONSTRATION OF EQUIPMENT

- A. After completion of installation, all equipment using water, gas, and electricity shall be performance inspected and tested by a factory certified service agent, including wet test of hood fire suppression systems, if so required. Food Service Equipment Contractor shall document that these inspections have been performed prior to scheduling demonstrations and Owner acceptance of equipment.
- B. Food Service Equipment Contractor shall arrange to have all manufactured, mechanically operated equipment furnished under this contract demonstrated by authorized representatives of equipment manufacturers, these representatives to instruct Owner's designated personnel in use, care and maintenance of all items of equipment after same are in working order. Demonstration and instruction shall be held on dates designated by Owner.
- C. Food Service Equipment Contractor shall provide a competent service representative to be present when installation is put into operation.

3.5 EQUIPMENT HANDLING AND STORAGE

- A. Deliver equipment to site, properly crated and protected, and store in safe place, protected from damage until time for installation.

3.6 GUARANTEE

- A. Special Project Warranty: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. This warranty shall be in addition to, and not limitation of, the rights the Owner may have against the Contractor under the Contract Documents.
- B. Warranty Period:
 - 1 year minimum from date of Substantial Completion, all new equipment furnished.
 - 5-year warranty period on refrigeration compressors.
 - 10-year warranty period on walk-in panels.

3.7 OPERATING AND MAINTENANCE MANUALS

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- B. (4) Wire shelves
 - C. (4) Posts
 - D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- Shelving unit to be as manufactured by Metro, Model No. SE-245463K4-S-4, Eagle Group, or Quantum.

ITEM 2D WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 60"W x 24"D x 63"H
 - B. (4) Wire shelves
 - C. (4) Posts
 - D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- Shelving unit to be as manufactured by Metro, Model No. SE-246063K4-S-4, Eagle Group, or Quantum.

ITEM 03 COLD STORAGE ASSEMBLY QUANTITY AS SCHEDULED

Provide prefabricated cold storage room assembly of size and shape shown on plan and detail drawings. Exact overall size to be field verified prior to fabrication.

- A. Insulation:
Panels shall be insulated with 4" thick urethane, foamed or poured in place using HCPC (no CFC) blowing agent. Foam shall be 2.25 lb. density, 95% closed cell. Panels shall meet STME- 84 (UL-723) and be listed by Underwriters laboratories. Panels shall have a maximum flame spread of 25, maximum smoke developed of 450 minimum. Flash ignition of 600 degrees and minimum self-ignition of 800 degrees F.
- B. Coved corners:
Assembly shall be constructed so that all interior wall, floor, and ceiling intersections shall comply with N.S.F. requirements.
- C. Cam lock fasteners:
All panel intersections and wall, floor and ceiling intersections shall be secured by cam lock fasteners connected with 2" wide metal straps set in and surrounded by insulation.
- D. Finishes:
Exterior and interior finishes shall be as shown on drawings.
- E. Doors:
Door size and finish shall be as shown on drawings, and shall be furnished complete with sill wiper gasket, and a minimum of 3 spring loaded lift type hinges. Doors to be Super doors with a reinforced 14 ga. U-Channel steel frame, backed with additional 1/8" steel plate drilled and tapped where all hardware is mounted. 3/16" backing on all doors larger than 42" wide.
Exterior door to be equipped with automatic door closer.
Cooler and Freezer doors to be equipped with perimeter heat.
All doors to be equipped with heavy duty padlocking pull-handle lever, with inside safety release.
- F. Thermometers:
Each compartment to be provided with exterior flush mounted thermometer mounted at eye level to each door. Provide remote read-out for freezer compartment at exterior cooler door.
- G. Lights:
Each compartment to be furnished complete with manufacturer's standard light fixtures, having protective cover, mounted and pre-wired to switch with pilot light in door section. Extra light fixtures as needed to provide 30-foot candles 30" above floor. Lights to be furnished and installed by this section.
- H. Ceiling panels to be one piece, self-supporting and span full width of assembly when available.

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- I. Floor:
Recessed insulated floor by F.S.E.C. with .100 diamond tread.
Reinforced floor panels to support minimum 1200 pounds per square foot.
The floor and ceiling shall have maximum length panels to span full length of box, if possible, otherwise stagger joints so there are no common "four corner" intersections and no joints occur ring in doorways.
- J. Refrigeration System:
Shall be furnished by manufacturer as part of cold storage room assembly, provide each compartment with complete refrigeration system sized to maintain appropriate temperature. Provide temperature alarm system with remote read-out and recording capability. Condensing units to be air-cooled, remote. Units to have performance and wiring characteristics as scheduled on drawings. Refrigeration systems to be designed for use with R448 refrigerant. Condensing units to be provided with painted galvanized steel all-weather housing, controls, and crankcase heaters, all suitable for outdoor conditions, and located as shown on drawings. Evaporators to be low-silhouette type with adaptive defrost control equal to a Bally SmartVap+controller. Evaporators to be equipped with 2speed EC motors, running full speed while refrigeration is engaged, and running at 1/3 speed while system is pumped down; mounted at locations shown on drawings. Performance and wiring characteristics to be as scheduled on drawings. Condensing units shall be provided with 2 speed EC fan motors, running full speed while refrigeration is engaged and 1/2" speed while ambient temp is below 60 degrees Fahrenheit. Also, the crank case heater will be turned off at an ambient above 60 degrees Fahrenheit.
Evaporator drain lines to be provided by this section and extended to floor receptors outside assembly.
Freezer drain lines to be wrapped with heater cable and insulated with pre-molded foamed plastic insulation suitable for the application. Thickness as recommended by manufacturer.
Refrigerant piping to be ACR copper tubing, hard temper, with wrought fittings and silver solder joints. Insulate suction lines with pre-molded foamed plastic insulation, thickness as recommended by manufacturer for temperature and application.
Refrigeration systems to be provided with all required refrigerant piping, insulation, sight glass vibration eliminator, solenoid(s), dryer, suction line filter, expansion valve(s), thermostat(s), heat exchangers, and defrost timers, etc. as necessary for complete installation. Provide pump down control circuit consisting of thermostat and solenoid valve. All components including piping and insulation to be installed using accepted industry standards, manufacturer's instructions and first-class workmanship.
- K. Miscellaneous:
Assembly to be installed on depressed building slab. See detail drawing.
Provide 1/8" diamond tread wainscot along exposed front exterior of assembly mounted from floor to 48" A.F.F.
Provide trim strips, closure panels, etc., as necessary to trim assembly to adjacent building surfaces.
Provide removable top closure panels with "C" channel rails. Lift-out panel sections to have turn-down edges for strength and are not to exceed 4'-0" in length.
Provide plastic strip curtains at door locations, transparent vinyl overlapping strips, aluminum bar hanging rod and bracket, suitable for low temperature application, as manufactured by Curtron, Flexstrip Products, Inc., or equal. Size to suit openings.
Provide heated pressure relief port in freezer.
Provide sleeves properly located for utility entrance, drain lines, and refrigeration lines, and after lines are installed, fill sleeves with spray foam compound, suitable for use in refrigerated spaces.
Trim excess foam away and cover with stainless steel escutcheon.

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Cold storage room shall be erected by factory trained, or factory approved installers or shall be supervised by factory personnel. Refrigeration systems shall be furnished by cold storage room manufacturer and installed by factory approved personnel. Shop drawing submittal shall indicate who the installer is, and a letter of approval shall accompany the submittal indicating the manufacture's acceptance of the installers.

This specification does not constitute a complete description of cold storage assembly, also see plan and detail drawings.

L. Concealed Locking Bars

Each walk-in door shall be equipped with additional security by use of a foamed-in-place concealed locking bar. Locking bar to include provisions for a padlock so the door cannot prevent entrapment inside the walk-in.

Cold storage room assembly to be as manufactured by Bally, Arctic, Norlake, Thermo-Kool, American Panel, Imperial/Brown, or Masterbilt complying with specifications and drawings.

ITEM 4A DUNNAGE RACK QUANTITY AS SCHEDULED

Provide dunnage rack with the following features:

- A. 22" x 30" x 12"H
- B. Slotted
- C. With separate polymer tie for joining racks
- D. Corrosion proof polymer construction

Dunnage rack to be as manufactured by Metro, Model No. HP2230PD, Cambro, or Quantum.

ITEM 4B DUNNAGE RACK QUANTITY AS SCHEDULED

Provide dunnage rack with the following features:

- A. 22" x 48" x 12"H
- B. Slotted
- C. With separate polymer tie for joining racks
- D. Corrosion proof polymer construction

Dunnage rack to be as manufactured by Metro, Model No. HP2248PD, Cambro, or Quantum.

ITEM 05 CAN RACK QUANTITY AS SCHEDULED

Provide front loading can rack with the following features:

- B. Aluminum frame construction, all welded.
- C. Stationary, with adjustable flanged feet.
- D. Front loading, with inclined loading guides.
- E. Capacity of approximately 156 #10 cans.

Can rack to be as manufactured by Channel, Model CSR-156, Piper, or Eagle Group.

ITEM 06A WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 36"W x 24"D x 74"H
- B. (5) Wire shelves
- C. (4) Posts
- D. Epoxy-coated corrosion-resistant finish with antimicrobial protection

Shelving unit to be as manufactured by Metro, Model No. 5A537K3, Eagle Group, or Quantum.

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ITEM 06B WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 42"W x 24"D x 74"H
 - B. (5) Wire shelves
 - C. (4) Posts
 - D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- Shelving unit to be as manufactured by Metro, Model No. 5A547K3, Eagle Group, or Quantum.

ITEM 06C WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 60"W x 24"D x 74"H
 - B. (5) Wire shelves
 - C. (4) Posts
 - D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- Shelving unit to be as manufactured by Metro, Model No. 5A567K3, Eagle Group, or Quantum.

ITEM 07 HAND SINK QUANTITY AS SCHEDULED

Provide hand sink with the following features:

- A. Wall mount
 - B. 13-1/2" Wide x 9-3/4" Front-to-back x 6-3/4" Deep bowl
 - C. 304 Stainless steel construction
 - D. Splash mount faucet with wrist handles
 - E. Basket drain
- Hand sink to be as manufactured by Eagle Group, Model HSA-10-FW, Premier Stainless, or John Boos.

ITEM 08 GARBAGE CAN, INDOORS N.I.K.C.

This item is to be furnished and installed by owner.

ITEM 09 WORK TABLE, S/S TOP QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 120"W x 30"D
 - B. 14/300 Series stainless steel top
 - C. Rolled edge on front & back
 - D. Adjustable 18/300 series stainless steel undershelf with marine edge
 - E. Gusset system
 - F. (6) Stainless steel legs & adjustable bullet feet
- Work table to be as manufactured by Eagle Group, Model No. T30120SE, Premier Stainless, or Metro.

ITEM 10 NOT USED

ITEM 11 CLEAN DISHTABLE QUANTITY AS SCHEDULED

Provide clean dishtable with the following features:

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- A. Straight design
- B. 84"W x 30"D x 43-1/2"H Overall
- C. Left-to-right operation
- D. 14/304 Stainless steel top
- E. 8"H Backsplash
- F. Raised rolled edges on front & side
- G. Stainless steel legs & crossbracing
- H. Adjustable metal feet
- I. Table limit switch provision

Dishtable to be as manufactured by Eagle Group, Model CDTR-84-14/3, Premier Stainless, or John Boos.

ITEM 11.1 DISHTABLE SORTING SHELF QUANTITY AS SCHEDULED

Provide sorting shelf with the following features:

- A. Slanted, wall mounted
- B. Solid, 16/304 stainless steel
- C. 42"W x 21"D x 21-3/8"H
- D. Drip tube on left side

Sorting shelf to be as manufactured by Eagle Group, Model No. 605381-X, Premier Stainless, or John Boos.

ITEM 12 SOILED DISHTABLE QUANTITY AS SCHEDULED

Provide soiled dishtable with the following features:

- A. Straight design
- B. 84"W x 30"D x 43-1/2"H Overall
- C. Left-to-right operation
- D. 14/304 Stainless steel top, 8"H backsplash
- E. 20" x 20" x 8" Deep pre-rinse sink, lever drain
- F. (1) Deck mount faucet hole for pre-rinse
- G. Raised rolled edges on front & side
- H. Stainless steel legs & side bracing, adjustable feet
- I. Pre-rinse unit, deck mount
- J. Scrap block

Soiled dishtable to be manufactured by Eagle Group, Model SDDL-84-14/3, Premier Stainless, or John Boos.

ITEM 12.1 DISHTABLE SORTING SHELF QUANTITY AS SCHEDULED

Provide sorting shelf with the following features:

- A. Slanted, wall mounted
- B. Solid, 16/304 stainless steel
- C. 42"W x 21"D x 21-3/8"H
- D. Drip tube on left side

Sorting shelf to be as manufactured by Eagle Group, Model No. 605381-X, Premier Stainless, or John Boos.

ITEM 13 DISHWASHER, CONVEYOR TYPE QUANTITY AS SCHEDULED

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Provide single-tank rack conveyor type dishmachine, having the following features:

- A. 202 racks/hour
- B. Insulated hinged access doors, see hinging as shown on Plan
- C. .62 gallon/rack
- D. Stainless steel enclosure panels
- E. Microprocessor controls with Low Temperature & Dirty Water Indicator
- F. Energy efficient, energy recovery
- G. Automatic soil remover
- H. Voltage as scheduled, direct connections
- I. Internal hot water 30 kW electric booster
- J. Drain water tempering kit
- K. Left-to-right operation
- L. Standard height and feet
- M. Additional water softener required for water over 3-grains of hardness
- N. Table limit switch
- O. Electric tank heat 15kW

Dishmachine to be as manufactured by Hobart, Model CL44EN-ADV+BUILDUP, Champion, or CMA Dishmachines.

ITEM 14 PANT LEG HOOD QUANTITY AS SCHEDULED

This item to be custom fabricated in accord with General Requirements of specifications and with plan and detail drawings by approved fabricator.

ITEM 15 NOT USED

ITEM 16 THREE (3) COMPARTMENT SINK QUANTITY AS SCHEDULED

Provide three-compartment sink with drainboards as follows:

- A. 126"W x 35"D
- B. 14/304 Stainless steel top, coved corners
- C. 20" Wide x 28" front-to-back x 14" deep compartments, lever drains
- D. 30" Drainboard on left & right
- E. 9-1/2"H Backsplash with 1" upturn & tile edge
- F. (2) Sets of 8" OC splash mount faucet holes
- G. Rolled edges on front & side
- I. Stainless steel crossbracing on front and sides
- J. Stainless steel legs & adjustable bullet feet
- K. (2) T&S Brass B-0231 faucets

Three-compartment sink to be as manufactured by Eagle Group, Model FN2860-3-30-14/3, Premier Stainless, or John Boos.

ITEM 17 BEVERAGE DISPENSER, INSULATED QUANTITY AS SCHEDULED

Provide beverage dispenser having the following features:

- A. Beverage Carrier, 11-3/4 gallon
- B. 16-1/4"W x 20-3/4"D x 24-3/4"
- C. Insulated plastic

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D. Coffee beige color, standard
Unit to be as manufactured by Cambro, Model 1000LCD157, or Carlisle.

ITEM 18 TRAY CART FOR STACKED TRAYS QUANTITY AS SCHEDULED

Provide tray delivery cart with the following features:

- A. Extra heavy duty, 46" high
- B. (72) 13-7/8" x 15-1/4" x 2-1/2" insulated trays (on bottom shelf) + (32) trays & (2) 5-gallon beverage containers
- C. Total capacity up to 144 trays
- D. (3) HD tie-down straps with buckles
- E. Tubular handle
- F. All welded stainless-steel construction.
- F. 6" x 2" polyurethane casters (2 swivel, 2 rigid)

Tray cart to be as manufactured by Sammons, Model 2145-2-2849, Aladdin, or Dinex.

ITEM 19 REACH-IN REFRIGERATOR QUANTITY AS SCHEDULED

Provide reach-in refrigerator with the following features:

- A. Reach-in
- B. One-section
- C. 21.17 cu. ft.
- D. (1) Right-hand solid hinged door with locks
- E. (3) Shelves
- F. Electronic control
- G. LED interior lighting
- H. Digital display
- I. Stainless steel front, gray painted sides, aluminum interior
- J. Top-mounted self-contained refrigeration, R290 Hydrocarbon refrigerant
- K. Heavy Duty Casters, locking
- L. Voltage as scheduled, cord and plug

Reach-in refrigerator to be as manufactured by Beverage Air, Model No. HR1HC-1S, Kool-It, or Continental.

ITEM 20 NOT USED

ITEM 21 SERVING COUNTER, COLD FOOD QUANTITY AS SCHEDULED

Provide cold food counter module having the following features:

- A. Cold Pan Unit, electric
- B. 37"W x 26"D x 34"H, open base
- C. (2) 12" x 20" openings (20" front to back)
- D. Stainless steel construction
- E. Vertical corner bumpers
- F. 4" Heavy duty swivel casters (2 with brakes)
- G. Self-contained refrigeration
- H. Voltage as scheduled, cord and plug

Counter to be by Caddy, Model RIF-602, Piper, or Duke.

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ITEM 22 SERVING COUNTER, HOT FOOD QUANTITY AS SCHEDULED

Provide 5-well hot food counter of size and content as shown on plan drawings, having the following features:

- B. Electric, open base
- B. (5) 12" x 20" hot food wells
- C. 82"W x 26"D x 34"H
- D. Stainless steel construction
- E. Vertical corner bumpers
- F. Insulated wells with individual heat controls
- G. Tilted control panel
- H. 4" Heavy duty swivel casters (2 with brakes)
- I. Voltage as scheduled, cord and plug

Counter to be as manufactured by Caddy, Model TF-605, Piper, or Duke.

ITEM 23 WORK TABLE, S/S TOP QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 120"W x 24"D
- B. 14/300 Series stainless steel top
- C. Rolled edges on front and back
- D. Adjustable 18/300 series stainless steel undershelf with marine edge
- E. (6) Stainless steel legs & adjustable flanged feet

Work table to be as manufactured by Eagle Group, Model T24120SE, Premier Stainless, or Metro.

ITEM 24 WORK TABLE, S/S TOP QUANTITY AS SCHEDULED

Provide work table with the following features:

- A. 96"W x 30"D
- B. 14/300 Series stainless steel top
- C. Rolled edge front
- D. Adjustable 18/300 series stainless steel undershelf with marine edge
- E. (6) Stainless steel legs & adjustable bullet feet
- F. 20" x 20" x 14" Sink bowls, lever drains
- G. Extra HD T&S deck mounted faucet w/4" centers, rigid gooseneck nozzle, 4" wrist handles

Work table to be as manufactured by Eagle Group, Model T3096SE-BS, Premier Stainless, or Metro.

ITEM 25 WORK TABLE QUANTITY AS SCHEDULED

Provide work table having the following features:

- A. 96"W x 30"D, 4-1/2" backsplash
- B. 14/300 Series stainless steel top, rolled edge on front edge
- D. Gusset system
- E. Stainless steel crossrails on side & rear
- E. (6) Stainless steel legs, adjustable bullet feet

Worktable is to be manufactured by Eagle Group, Model T3096STEB-BS, Premier Stainless, or Metro.

ITEM 26 ICE CUBE MAKER, W/ BIN QUANTITY AS SCHEDULED

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Provide ice maker and bin having the following features:

- C. Cube style, air-cooled, self-contained condenser, 22" W
- B. Dual exhaust top/side air discharge
- C. Approximately 561 lb. production/24 hours at 70°/50°
- D. Full-size cubes
- E. Built-in antimicrobial protection
- F. LED status display
- G. One touch sanitize/descaling controls
- H. Dishwasher safe food zone components
- I. Voltage as scheduled, direct connection
- J. Backflow preventer
- K. Water filtration system
- J. Plastic ice shovel with hanging bracket
- K. Bin top
- L. B55PS Bin top, KBT19 bin kit

Unit to be as manufactured by Ice-O-Matic, Model CIM0520FA, Scotsman, or Hoshizaki.

ITEM 27 BEVERAGE COUNTER QUANTITY AS SCHEDULED

Provide beverage counter with the following features:

- A. Cabinet base with open front
- B. 96"W x 30"D x 45-3/4"H overall size
- C. 14/300 Stainless steel top with 10" backsplash
- D. Marine edge top, safety edge front and square turndown ends
- E. (1) 18"W x 18" front-to-back x 12" deep sink on right, lever drain
- F. (1) Set of splash mount faucet holes with 4" centers, 3-1/2" drain opening
- G. Hinged door in front of sink
- H. 36" Urn trough & louvered grate with 2" drain
- I. (1) Intermediate shelf, includes 1-ph duplex outlet in backsplash, voltage as scheduled
- J. 18/430 Stainless steel wrap with legs & adjustable feet
- K. T&S Brass 0331-CC wall mounted faucet

Beverage counter to be as manufactured by John Boos, Model No. 4CB4R10-3096-R, Eagle Group, or Premier Stainless.

ITEM 28 TEA BREWER N.I.K.C.

This item is to be furnished and installed by Vendor.

ITEM 29 COFFEE MAKER/BREWER URN N.I.K.C.

This item is to be furnished and installed by Vendor.

ITEM 30 NOT USED

ITEM 31 REACH-IN HEATED CABINET QUANTITY AS SCHEDULED

Provide reach-in heated cabinet having the following features:

- A. Reach-in
- B. One-section

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- N. Single pantry fill faucet, 12" swing spout
 - O. Voltage as scheduled, cord and plug
 - P. Water filter
 - Q. Quick gas disconnect
- Kettle to be as manufactured by Crown, Model GL-20E, Cleveland, or Groen.

ITEM 34 TILTING SKILLET BRAISING PAN QUANTITY AS SCHEDULED

Provide gas tilting braising pan with the following features:

- A. Gas heated, natural
- B. 30-gallon capacity
- C. 9.5" deep skillet pan with etched gallon markings
- D. Open leg frame base
- E. Standard with manual tilt mechanism
- F. Spring assist cover
- G. Stainless steel pan and frame
- I. Pilot ignition
- J. Single pantry faucet kit
- K. Voltage as scheduled, cord and plug
- L. Quick gas disconnect
- M. Water filter

Tilting braising pan to be as manufactured by Market Forge, Model 30P-STGL, Cleveland, or Groen.

ITEM 35 FLOOR TROUGH QUANTITY AS SCHEDULED

Provide floor trough having the following features:

- A. Anti-Spill Floor Trough, 30"W x 18"D x 6" deep receptacle
- B. (1) 4" OD tailpiece, stainless steel beehive strainer
- C. 14/304 stainless steel
- D. Brushed satin finish
- E. (PFG) pultruded fiberglass grating

Floor trough to be IMC/Teddy, Model ASFT-1830-PFG, Premier Stainless, or John Boos.

ITEM 36 HD RANGE, 36", MANUAL GRIDDLE QUANTITY AS SCHEDULED

Provide electric range with griddle having the following features:

- A. Heavy Duty Range, 36" with griddle
- B. Gas heated, natural
- C. 3/4" Thick polished steel plate
- D. Standard oven
- E. Stainless steel front, top front ledge, sides, base, burner box & stub back, 6" adjustable legs
- F. 1-1/4" Rear gas connection, cap & cover, both ends
- G. 4 3/4" x 4' long gas flex hose & quick disconnect with restraining device
- H. Voltage as scheduled, cord and plug
- I. S/S high shelf

Range to be as manufactured by Vulcan, Model VGM-36S, Royal Range, or Cleveland.

ITEM 37 CONVECTION OVEN, GAS QUANTITY AS SCHEDULED

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ITEM 40 NOT USED

ITEM 41 TWO (2) COMPARTMENT SINK QUANTITY AS SCHEDULED

Provide two-compartment sink with drainboards as follows:

- A. Two-compartment
- B. 96"W x 27"D
- C. 16/300 stainless steel construction, coved corners
- D. 16"W x 20" front-to-back x 14" deep compartments, lever wastes
- E. 30" Drainboards on left and right
- F. 10"H backsplash
- G. 8" OC splash mount faucet holes
- H. 1-1/2" Raised-rolled edge on front & sides
- I. T&S Brass B-0231 faucet

Sink to be as manufactured by Eagle Group, Model FN2032-2-30-14/3, Premier Stainless, or John Boos.

ITEM 43 CONVECTION STEAMER QUANTITY AS SCHEDULED

Provide convection steamer having the following features:

- A. Electric
- B. Boilerless
- C. Double stacked
- D. Stationary open frame stacking stand with rear flanged feet
- E. (6) Full size pan capacity per compartment
- F. Filtered water system shared with Combi-Oven, item 32
- G. 60-Minute electro-mechanical timer & manual (continuous steaming) bypass switch
- H. Left-hand hinged door, controls on right
- I. Automatic drain & water level controls
- J. Voltage as scheduled, direct connection
- L. Backflow preventer
- M. Equipment stand

Convection steamer to be as manufactured by Cleveland, Model (2) 22CET66.1, Accu-Temp, or Groen.

ITEM 44 PLANETARY MIXER QUANTITY AS SCHEDULED

Provide 40-quart gear-driven bench type mixer having the following features:

- A. 40-quart capacity
- B. (3) Fixed speeds plus stir speed
- C. Gear-driven transmission
- D. 20- Minute timer
- E. #12 Taper hub
- F. Manual bowl lift
- G. Stainless steel bowl, aluminum "B" beater, stainless steel "D" wire whip, aluminum "ED" spiral dough arm, stainless steel bowl guard
- H. Voltage as scheduled, direct connection

Mixer to be as manufactured by Hobart, Model HL400-4STD, Univex, or Globe.

ITEM 45 FOOD SLICER, ELECTRIC QUANTITY AS SCHEDULED

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Provide slicer having the following features:

- A. Manual, 13" knife
- B. Burnished finish
- C. Removable meat/vegetable grip arm
- D. Removable ring guard cover
- E. Single action top mounted sharpener with stones
- F. Cleaning kickstand
- G. Voltage as scheduled, cord and plug
- H. 27"W x 32"D x 32"H Equipment stand with undershelf, adjustable legs

Slicer to be as manufactured by Hobart, Model HS6N-1, Globe, or Univex.

ITEM 46 FOOD PROCESSOR QUANTITY AS SCHEDULED

Provide food processor with the following features:

- A. 4-quart bowl design
- B. 1725 rpm
- C. Stainless steel bowl with see-thru cover and bowl-scraper
- D. Direct drive motor, 3/4 HP
- E. Triple safety interlocks
- F. Anodized aluminum base, rubber feet
- G. Voltage as scheduled, 8' cord and plug

Processor to be as manufactured by Hobart, Model FP41-1, Berkel, or Sammic.

ITEM 47 INGREDIENT BIN QUANTITY AS SCHEDULED

Provide ingredient bin with the following features:

- A. Mobile
- B. 27-Gallon capacity
- C. 1-Pc seamless polyethylene bin
- D. 2-Pc sliding polycarbonate lid
- E. S-hook on front (scoop NOT included)
- F. (4 3" Heavy duty casters (2) front swivel, 2 fixed
- G. White with clear cover

Ingredient bin to be as manufactured by Cambro, Model IBS27148, Winco, or Win-Holt.

ITEM 48 BUN/ SHEET PAN RACK QUANTITY AS SCHEDULED

Provide pan rack having the following features:

- A. Utility Rack, mobile
- B. Angle ledge, full height, open sides
- C. Riveted pan slides with extruded angle
- D. 5-1/8" centers
- E. (24) 14" x 18" tray or (12) 18" x 26" pan capacity
- F. End loading
- G. Fully welded aluminum frame construction
- H. (4) 5" Swivel casters (2) braked

Pan rack to be as manufactured by CresCor, Model 2071812, Lakeside, or Piper.

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ITEM 49 SHELVING UNIT QUANTITY AS SCHEDULED

Provide poly/wire shelving unit with the following features:

- A. 48"W x 24"D x 80"H
- B. (4) Open grid shelves with epoxy coated steel frames & removable polymer shelf mats
- C. (1) Solid shelf
- D. (4) Polymer posts
- E. Microban antimicrobial product protection
- F. (4) Swivel 5" casters with polyurethane treads (2 braked)

Shelving unit to be as manufactured by Metro, Model No. 5Q557EG3.

ITEM 50 NOT USED

ITEM 51 55 LB. COMMERCIAL WASHER QUANTITY AS SCHEDULED

Provide soft-mount Washer-Extractor with the following features:

- A. 99 programming options
- B. Slanted accessible control panel
- C. Stainless steel front, top and side panels
- D. Stainless steel inner drum and tub
- E. Large drain valve
- F. High-capacity water inlets
- G. Four (4) compartment dispenser
- H. Eight (8) liquid chemical connections
- I. Thirteen (13) chemical ports of various sizes including 1/2" manifold flush connections
- J. Large door opening
- K. Ozone-compatible design
- L. Durable micro-v belt
- M. Voltage as scheduled, direction connection

Washer-Extractor to be as manufactured by Unimac, Model UY55, Cissell, or Summit.

ITEM 52 75 LB COMMERCIAL DRYER QUANTITY AS SCHEDULED

Provide dryer with the following features:

- A. Boosted energy and air flow
- B. Multiple burner heat system provide quick, stable temperature control
- C. Electrostatically applied paint for exterior finish
- D. Self-cleaning lint filter
- E. Galvanized pre-coated steel cylinder
- F. Embossed steel front and side panel
- G. Reversing cylinder option
- H. Solid steel cap over top of dryer
- I. Extended tumble to prevent wrinkling
- J. Long-lasting heavy duty rubber door gasket
- K. Voltage as scheduled, direct connection

Dryer to be as manufactured by Unimac, Model UT-75, Cissell, or Summit.

ITEM 53 FOLDING TABLE QUANTITY AS SCHEDULED

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Provide locking folding table with the following features:

- A. Rectangle
- B. 72"W x 30"D
- C. 675 Lbs. maximum capacity
- D. 18/430 Stainless steel top
- E. Painted mild steel folding legs

Folding table to be as manufactured by Eagle Group, Model No. T3072F, Premier Stainless, or John Boos.

ITEM 54A WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 48"W x 24"D x 74"H
- B. (5) Wire shelves
- C. (4) Posts
- D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- E. Caster mounted

Shelving unit to be as manufactured by Metro, Model No. 5A557K3, Eagle Group, or Quantum.

ITEM 54B WIRE SHELVING UNIT QUANTITY AS SCHEDULED

Provide wire shelving unit with the following features:

- A. 60"W x 24"D x 74"H
- B. (5) Wire shelves
- C. (4) Posts
- D. Epoxy-coated corrosion-resistant finish with antimicrobial protection
- E. Caster mounted

Shelving unit to be as manufactured by Metro, Model No. 5A567K3, Eagle Group, or Quantum.

ITEMS 55 ONE (1) COMPARTMENT SINK QUANTITY AS SCHEDULED

Provide one (1) compartment sink with the following features:

- A. 25-3/8"W x 25"D
- B. 16/430 Stainless steel construction
- C. 24" Wide x 21" Front-to- back x 13-3/8" Deep compartment, lever drain
- D. 8"H Backsplash with 1" upturn
- E. 8" OC Splash mount faucet holes
- F. 2" Euro- style front edge & rolled side edges
- G. Includes 3-1/2" basket drain
- H. Galvanized legs with adjustable plastic bullet feet
- I. Faucet

Sink to be as manufacture by Eagle Group, Model 2124-1-16/4, Premier Stainless, or John Boos.

END OF SECTION 114000

**SECTION 122400
WINDOW SHADES**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- C. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized installation representative of fabricator/manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following minimum terms:
 - 1. Manual Operating Mechanism / Clutch: 10 years, minimum (excludes bead chain).
 - 2. Fabric: 10 years, minimum.
 - 3. Balance of Shade Hardware and Non-Operating Materials and Components: 25 years, minimum.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 - 1. Draper, Inc; Clutch Operated FlexShade.
 - 2. Hunter Douglas Architectural; RB500 Manual Roller Shades.
 - 3. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades.
 - 4. MechoShade Systems LLC; Mecho/5 System.
 - 5. WT Shade; HeliaRise.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Source Limitations: Provide products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades:
 - 1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Roll Direction: Roll down, closed position is at window sill.
 - c. Mounting: Window jamb mounted - inside, between jambs.
 - d. Size: As indicated on drawings for rough opening sizes; field verify rough openings prior to fabrication.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - 3. Roller Tubes: As required for type of shade operation.
 - a. Material: Extruded aluminum, clear anodized finish or electrogalvanized/epoxy primed steel, as standard with manufacturer.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize manufacturer's standard method for attaching shade fabric material to rollers.
 - 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
 - 5. Manual Operation for Interior Shades:

- a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
- b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
- 6. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
 - b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
 - c. Ceiling Pockets: Premanufactured metal shade pocket for recess mounting shade hardware into ceiling. Provide removable closure panel to conceal underside of brackets and roller tubes.
 - d. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Manufacturers:
 - a. Lutron Electronics Co., Inc; Basketweave 27 - 1% .
 - b. Mermet Corporation; E-Screen - 1%.
 - c. Phifer, Inc; Style 2500 1%.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Material: Vinyl coated fiberglass.
 - 3. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 - 4. Color: To be selected by Architect from manufacturer's full range.
 - 5. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. If height of opening requires multiple panels of railroaded fabric, use manufacturer's standard sewn seams.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/4 inch maximum space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb, with maximum 1/4 inch gap at each edge of jamb.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
 - B. Start of installation shall be considered acceptance of substrates.
-

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 122400

SECTION 123553.19
WOOD LABORATORY CASEWORK

PART 1 GENERAL

1.01 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.02 REFERENCE STANDARDS

- A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.
- B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. AWI (QCP) - Quality Certification Program.
- D. BHMA A156.9 - Cabinet Hardware.
- E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
- F. ICC (IFC) - International Fire Code.
- G. NFPA 1 - Fire Code.
- H. NFPA 30 - Flammable and Combustible Liquids Code.
- I. SEFA 1 - Laboratory Fume Hoods.
- J. SEFA 2 - Installations.
- K. SEFA 7 - Laboratory Fixtures.
- L. SEFA 8W - Laboratory Grade Wood Casework.
- M. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of casework with related items.
 - 1. Service Fixtures: Coordinate location and characteristics of service connections.
 - 2. Equipment and Instruments: Coordinate installation of casework with equipment and scientific instruments.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

1.04 SUBMITTALS

- A. Product Data: Component dimensions, configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware, accessories, and service fittings, if any.

- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any.
- C. Samples For Color Selection: Wood samples, fully finished, for color and species selection. Minimum Sample Size: 2 inches by 3 inches.
- D. Test Reports: From independent laboratory indicating compliance with referenced chemical-resistance standards for cabinet finish and liner materials.
- E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- F. Finish touch-up kit for each type and color of materials provided.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with SEFA 8W certification for wood casework.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
 - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
 - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" paragraph of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Laboratory Casework:
 - 1. Diversified Woodcrafts.
 - 2. Institutional Casework Inc (ICI Scientific).
 - 3. Kewaunee Scientific Corp.
 - 4. Leonard Peterson & Co., Inc.
 - 5. Mott Manufacturing.
 - 6. Stevens Industries.
- B. Countertops:
 - 1. Durcon (Epoxy resin, Solid phenolic).
 - 2. Kewaunee Scientific Corp.
 - 3. Mott Manufacturing.
- C. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 WOOD LABORATORY CASEWORK

- A. Wood Laboratory Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
 - a. Base Cabinets: 22 inches.
 - b. Tall Cabinets: 22 inches.
 - c. Upper Cabinets: 16 inches.
 3. Construction: Joints doweled, glued and screwed, except drawers may be lock-shoulder jointed; with interior of units smooth and flush; cabinet bottom flush with top of face frame; without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
 4. Seismic Performance: Casework, including attachments to other work, able to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - a. Component Importance Factor: 1.0.
 5. Fittings and Fixture Locations: Cut and drill counter tops, backs, and other components for service outlets and fixtures.
 6. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
 7. Factory-finish all exposed and semi-exposed surfaces with the same finish.
 - a. Finish Performance: Provide finish on all surfaces having chemical resistance of Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8W and no visible effect when surface is exposed to:
 - 1) Hot water at temperature between 190 degrees F and 205 degrees F trickled down the test surface at 45 degree angle for 5 minutes.
 - 2) Constant moisture in the form of 2 by 3 by 1 inch thick cellulose sponge kept continually saturated with water and in contact with test surface for 100 hours.
 - b. Preparation: Wood sanded smooth, free from dust and mill marks.
 - c. Stain: Single application of clean, manufacturer-recommended stain of selected color; tinted coating not acceptable.
 - d. Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
 - e. Coats: Multiple coats as required to achieve minimum 1.5 mil dry film thickness.
 - f. Appearance: Clear satin gloss; not cloudy or muddy.
- B. Acid Storage Cabinets: Construction identical to other cabinets, with following exceptions:
1. Completely lined with corrosion-resistant liner material; stainless steel fasteners for all connections and hardware inside cabinets.
 2. Shelves: Removable, same material as cabinet, covered with corrosion-resistant liner.
 3. Bottom Pan: Liquid-tight liner covering entire bottom of acid-storage cabinet.
- C. Solvent (Flammable and Combustible Liquids) Storage Cabinets: Pre-fabricated steel cabinets, complying with the following:
1. Construct to NFPA 30 and applicable OSHA requirements.
 2. Fire Resistance: Maximum internal temperature of 325 degrees F at the center, and 1 inch from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in ASTM E119.

3. Shelves: Full depth, adjustable.
4. Bottom Pan: 2 inches deep, corrosion-resistant, liquid-tight pan covering entire bottom of cabinet.
5. Cabinet Hardware: UL-listed.
 - a. Hinges: Full-length stainless steel continuous (piano) hinges.
 - b. Self-closing Doors: Comply with requirements of NFPA 1 and ICC (IFC). Minimum 90 degree opening. Three-point latch arrangement, door(s) shutting and latching automatically when hold-open device's fusible link melts at 165 degrees F under fire conditions outside the cabinet. At pair of doors, synchronize latching so that both doors always fully close.
 - c. Door Handles: Manufacturer's standard, with slip-resistant grip.
 - 1) Provide manufacturer's standard cylinder lock and key set.
6. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.

2.03 CABINET HARDWARE

- A. Comply with BHMA A156.9 requirements.
- B. Shelves in Cabinets:
 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- C. Swinging Doors:
 1. Hinges: Offset pin, number as required by referenced standards for width, height, and weight of door.
 - a. European-Style Hinges: For overlay doors, concealed. Steel, nickel-plated, 110 degree opening angle.
 2. Catches: Magnetic.
 3. Pulls: Chrome wire pulls, 4 inches wide.
- D. Drawers:
 1. Pulls: Chrome wire pulls, 4 inches wide.
 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.04 COUNTERTOPS

- A. Countertops:
 1. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
 - a. Flat Surface Thickness: 1 inch, nominal.
 - b. Surface Finish: Smooth, non-glare.
 - c. Color: As selected by Architect from manufacturer's full range.
 - d. Exposed Edges and Corners: Beveled or radiused approximately 3/16 inch.
 - e. Drip Edge: Drip groove 1/8 inch wide and deep, located 1/2 inch back from edge on underside of each exposed edge.
 - f. Back and End Splashes: Same material, same thickness; separate for field attachment.

2.05 SINKS

- A. Laboratory sinks.
 - 1. General: Sinks with perimeter lip for drop-in installation.
 - 2. Sink: Single-bowl.
 - a. Basis of Design: Model Model A26 manufactured by Durcon.
 - b. Material: Epoxy
 - c. Mounting: Drop-in.
 - d. Size: 18 inch wide by 15 inch front-to-back by 5 inch deep for ADA-compliance and 11 inch deep for non-ADA.
 - e. Outlet: 4.5 inch NPS outlet with tailpiece.
 - 1) Placement: Corner.
- B. Non-laboratory sinks are identified on drawings and are specified in Section 224000.

2.06 MISCELLANEOUS LAB CASEWORK AND ACCESSORIES

- A. Fire Blanket: Minimum 62-inch by 80-inch woven blanket treated with fire-resistant chemicals to conform to Federal Specification #CS-191-53.

2.07 FUME HOODS

- A. General Requirements: Provide manufacturer's standard complete fume hood assembly, fabricated of steel internal structure and sheet steel cladding with manufacturer's standard chemical-resistant finish.
 - 1. Comply with SEFA 1; and provide fume hoods UL listed and labeled for compliance with UL 1805; include labeling on the face of fume hood.
 - 2. Configuration: Bench top type, 48 inch nominal width, with 34 inch height to work surface. Provide ADA-compliant base stand. Provide "ceiling skirt" finished to match steel sheet cladding to close fume hood to ceiling, with hinged access panel.
 - 3. Interior Construction: Provide epoxy resin internal countertop work surface and manufacturer's standard lining of epoxy-coated steel sheet or glass-fiber-reinforced epoxy.
 - 4. Sash: Provide vertical operating sash fabricated of steel sheet and 1/4 inch tempered safety glass, with counter-balance system designed to allow operation at a maximum 7 pounds of force over complete travel height; counter-balance shall be capable of holding sash open at any position without creep. Provide rubber bumpers at limit of travel horizontally and vertically.
 - 5. Fittings: Provide gooseneck faucet, epoxy resin cup sink, and gas turret with ball valve within the fume hood. Provide a recessed duplex outlet on hood face.
 - 6. Pre-wire fume hoods for service fittings, light fixtures and receptacles. Coordinate with Division 22, 23, and 26 contractors to ensure utility services are properly sized and located.
 - a. Terminate all wiring in a junction box on top of hood.
- B. Fume Hood Base Stands: ADA-compliant open table support frame in width and depth required for fume hood.
 - 1. Construction: Welded steel tubing legs, not less than 2 inches square.
 - a. Color/Finish: As selected by Architect from manufacturer's standard range.
 - b. Leg Levelers: Manufacturer's standard.
 - c. Structural Performance: Capable of withstanding 75 pounds per foot worktop, plus weight of hood, without permanent deformation or excessive deflection.

- d. Knee Space: Clear floor space not less than 36 inches wide by 25 inches front to back, by 27 inches high, unless otherwise indicated.
- C. Restricted-Bypass Fume Hoods:
 - 1. Standard Performance: Fume hood shall be tested per ASHRAE Std 110 and shall provide an average face velocity of 100 fpm with sash fully open, with no more than 10 percent variation.
 - 2. Bypass: Provide a compensating bypass arrangement above the sash to open after sash is closed to less than 20 percent open. Bypass to maintain exhaust capacity of at least 25 CFM per square foot of work surface regardless of sash position.
 - 3. Provide an electronic control unit designed to use input from a sensor that monitors face velocity or sash position to modulate a dedicated exhaust damper in order to maintain a near-constant fume hood face velocity.
 - a. Provide with safety monitor/alarm system that monitors face velocity and provides audible and visual alarm if face velocity drops below safe levels.
 - b. Provide control unit with a manual-override switch that allows the operator to fully open the exhaust damper.
 - c. Provide control unit with outputs for interfacing with building's HVAC control system.
- D. Electrical Fixtures: LED light and tubes with switch; duplex 15v/20-amp, GFCI receptacle.

2.08 LABORATORY EMERGENCY EQUIPMENT PLUMBING FIXTURES

- A. Eye/Face Wash Units: Deck-mounted units.
 - 1. As specified in Section 224200.

2.09 SERVICE FITTINGS

- A. General: Comply with requirements of SEFA 7.
- B. Water Service Fittings and Fixtures:
 - 1. Water, Mixing Faucet :
 - a. Basis of Design: Model #VR411VB-55-BH manufactured by Water Saver.
 - 2. Escutcheons: Polished chrome.
- C. Control Valves for Fume Hoods: Remote-type valves as specified above, except provide complete with aluminum extension rods and escutcheon plates,

2.10 MATERIALS

- A. Wood-Based Materials:
 - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
 - 2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.
 - B. Exposed Solid Wood: Clear, dry, sound, selected for compatible grain and color, no defects.
 - 1. Wood Species: White maple; plain sliced.
 - C. Exposed Hardwood Plywood: Veneer core; HPVA HP-1 Grade A, same species as exposed solid wood, clear, compatible grain and color, no defects; minimum 1/50 inch thick. Band exposed edges with Grade J solid wood of same species as veneer.
 - D. Semi-Exposed Hardwood Plywood: Veneer core; HPVA HP-1 Grade B or C, any species similar in color and grain to exposed portions. Band exposed edges with Grade J solid wood of same species as veneer.
 - E. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.
-

- F. Solid Epoxy Resin: Modified epoxy resin and non-asbestos inert fillers cast into sheets.
- G. Solvent-Resistant Liner Material: High-density, asbestos-free, non-combustible, calcium-silicate-based panel consisting of autoclaved Portland cement, mineral fillers and synthetic fibers.
- H. Sealant for Use in Casework Installation:
 - 1. Manufacturer's recommended type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

3.02 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
 - 1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
 - 2. Wall Cabinets: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 - a. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
 - b. Maximum Variation of finished gypsum board surface from true flatness exceeds 1/8 inch in 10 feet in any direction.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.
- H. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- I. Vented Cabinets: Install in strict compliance with manufacturer's written installation instructions.
 - 1. Install vent kits and connect to fume hood exhaust system.
 - 2. Use only rigid materials for venting. No flexible materials permitted.
- J. Coordinate installation of work of this section with installation of fume hoods and laboratory equipment.
- K. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.
- L. Replace units that are damaged, including those that have damaged finishes.

3.03 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.04 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

3.05 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 123553.19

**SECTION 133419
METAL BUILDING SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- F. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- L. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- P. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- Q. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.
- R. MBMA (MBSM) - Metal Building Systems Manual.
- S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
- T. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

- A. Product Data: Provide data on each metal building system component, including profiles, component dimensions, and anchors and fasteners.

- B. Shop Drawings: Indicate assembly dimensions, locations of structural members, framed openings, connections, and attachments; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation/footing loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
- C. Samples: For components requiring color selection, including roof panels, gutters and downspouts, provide manufacturer's color charts indicating standard range of colors. Clearly indicate on color charts which colors are compliant with SRI requirements.
- D. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
 - 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
 - 1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
 - 2. Comply with applicable code for submission of design calculations as required for acquiring permits.
- B. Perform work in accordance with AISC 360 and MBMA (MBSM).
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Accredited by IAS in accordance with IAS AC472.
- D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.05 DELIVERY, STORAGE, AND HANDLING

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a three year period after Date of Substantial Completion.
- C. Provide a twenty year manufacturer warranty covering deterioration or color loss on metal panel finishes.
- D. Provide a twenty year weathertightness warranty for metal roof assembly.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Buildings Systems:
 - 1. Butler Manufacturing Company.
 - 2. Ceco Building Systems.
 - 3. Kirby Building Systems, a Nucor Company.
 - 4. Nucor Building Systems.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 ASSEMBLIES

- A. Frame Type: Single span rigid frame.
- B. Bay Spacings: As indicated on Drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams and braced end frames, and wind bracing.
- D. Secondary Framing: Purlins and girts. Provide other items as detailed, and provide accessory struts, bracing, clips, gussets, and other accessory framing components as required by structural design.
- E. Wall and Roof Systems: Preformed metal panels of indicated profiles, with sub-girt framing/anchorage assembly and insulation, and accessory components.
- F. Roof Slope: As indicated on Drawings.

2.03 PERFORMANCE REQUIREMENTS

- A. Design structural members to withstand dead load, applicable snow load, and design loads due to pressure and suction of wind calculated in accordance with applicable code and as indicated on Structural Drawings; with maximum deflections and drift limit per below:
 - 1. Purlins and Rafters: Maximum allowable deflection of 1/240 of span.
 - 2. Top of Wall Wind Girts: Maximum horizontal deflection as indicated on Structural Drawings.
 - 3. Exterior Wall and Roof System Panels: Maximum allowable deflection of 1/240 of span.
 - 4. Lateral Drift: Maximum drift of 1/400 of total building height.
 - 5. Secondary framing members shall be designed to withstand deflection of primary members within construction tolerances, and to maintain clearances at openings.
- B. Metal building columns shall have pinned bases and shall transfer no moments to the foundations.
- C. Design structural members to withstand Class 60 wind uplift in accordance with UL 580.
- D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- E. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to an temperature range of 120 degrees F and temperature range at material surfaces of 180 degrees F.
- F. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.04 MATERIALS - FRAMING

- A. Structural Steel Members: ASTM A36/A36M.
- B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
- C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
- D. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with protective coating.
- E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
- F. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.
- G. Primer: SSPC-Paint 20 zinc rich.
- H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

2.05 MATERIALS - WALLS AND ROOF

- A. Steel Sheet: Provide one of the following
 - 1. Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
 - 2. Aluminum-zinc alloy, ASTM A792/A792M, coated to AZ50/AZM150.
- B. Insulation (Framing Cavity): Batt glass fiber type, unfaced, ASTM E84 Class A, flame spread index of 25 or less where exposed, friction fit, thickness as required for R-value/U-factor indicated.
- C. Thermal Spacer Blocks: Provide manufacturer's standard thermal spacer blocks fabricated of rigid foam with metal facings. Locate thermal spacer blocks between steel framing and roof insulation to provide a complete continuous insulation assembly meeting thermal performance requirements indicated.
- D. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
- E. Bituminous Paint: Asphaltic type.
- F. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
- G. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Fascias and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.06 COMPONENTS

- A. Doors and Frames: Refer to Division 8 section "Hollow Metal Doors and Frames."
- B. Windows: Manufacturer's standard.
 - 1. Glass and Glazing: Refer to Division 8 section "Glazing."

2.07 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- C. Provide accessory framing for door and window openings, as required.
- D. Provide wall opening framing for doors, windows, and other accessory components.

2.08 FABRICATION - WALL AND ROOF PANELS

- A. Wall Panels: Minimum 24 gauge (0.0222-inch) metal thickness. All panels shall be vertically oriented and have lapped edges fitted with continuous gaskets/sealant at seams.
 - 1. Trapezoidal Rib R-Panel/PBR-Panel Profile: Nominal 36-inch wide panel with 1-1/4 inch deep trapezoidal ribs at 12 inches o.c, with intermediate stiffening ribs/striations between primary ribs.
- B. Roof Panels: Minimum 24 gauge (0.0222-inch) metal thickness. All panels shall have lapped edges fitted with continuous gaskets/sealant at seams.
 - 1. Trapezoidal Rib PBR-Panel Profile: Nominal 36-inch wide panel with 1-1/4 inch deep trapezoidal ribs at 12 inches o.c, with intermediate stiffening ribs/striations between primary ribs. "R-panel" profile with shorter lap is not acceptable at roof applications.
- C. Girts/Purlins: Rolled formed structural shape to receive roofing panel.
- D. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners sheet.
- E. Expansion Joints: Same material and finish as adjacent material where exposed, manufacturer's standard brake formed type, of profile to suit system.
- F. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
- G. Fasteners: To maintain load requirements and with integral gaskets for weather tight installation, same finish as cladding, non-corrosive type.

2.09 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts of manufacturer's standard box / rectangular profile and sized to collect and remove water. Fabricate with all required elbows, outlets, splices, and other connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Provide concealed galvanized steel support straps / gutter hangers. Gutter supports shall be spaced per manufacturer requirements, but no greater than 24 inches o.c.
- E. Splash Blocks: Provide heavy-duty concrete splash blocks at base of each downspout to direct water away from base of wall unless connection to underground sewer system is indicated. Lightweight "patio" blocks are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.02 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.

- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.03 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners.
- G. Install manufacturer's insulation assembly in accordance with manufacturer's instructions to comply with required Performance Requirements.
- H. Install sealant and gaskets, providing weather tight installation.

3.04 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Slope gutters minimum 1/8 inch per foot.
- C. Connect downspouts to underground storm sewer system where indicated.
- D. Install outward facing elbow and splash block at base of each downspout not indicated to connect to underground storm sewer.

3.05 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, and windows and glass in accordance with manufacturer's instructions.

3.06 TOLERANCES

- A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
- B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION 133419

SECTION 134263.16
MANUFACTURED STEEL DETENTION CELLS

PART 1 - GENERAL

1.1 SCOPE

- A. This specification covers the requirements, including labor, materials, services, and equipment for the manufacturing, delivering, and installing of pre-engineered, prefabricated Steel Detention Cells.
1. The Detention Cell Manufacturer (DCM) shall provide the following materials:
 - a. Prefabricated housing cells - Typical and Barrier-Free.
 - b. Associated closure pieces between modular units and other adjacent wall types.
 2. Requirements for all bidders:
 - a. Submit current reports for all performance testing:
 - 1) ASTM F2322-12; Physical Assault on Vertical Fixed Barriers for Detentions and Correctional Facilities.
 - 2) ASTM F1450-12a; Hollow Metal Swinging Door Assemblies for Detention Facilities.
 - b. Submit performance testing for coating system: Polyurea or Powder Coating
 - 1) Polyurea:
 - a) Adhesion to galvanized steel: ASTM D4541, 800 PSI.
 - b) Tensile Strength: ASTM D638, 3000PSI.
 - c) Elongation: ASTM D638, 425 percent.
 - d) Hardness: ASTM D2240, Shore D51.
 - e) Tear Strength: ASTM D624, -580 PLI.
 - f) Abrasion Resistance: ASTM 4060, 1000g 1000 cycles.
 - g) Accelerated Weathering: ASTM G53 3000 Hrs.
 - h) Gardner Impact: ASTM 2794 160 in lbs.
 - i) Salt Fog Resistance: ASTM B117-90, 3000 Hrs.
 - 2) Powder Coating:
 - a) Pencil Hardness/Mar: ASTM D3363 2H.
 - b) Pencil Hardness/Gouge: ASTM D3363 6H.
 - c) Cross Hatch Adhesion: ASTM D3359 5B.
 - d) Salt Spray Resistance: ASTM B117.
 - e) 3000+ hours- 1/8 inch "x" scribe.
 - f) Impact Resistance: ASTM D2794 140.
 - c. To confirm experience the DCM must submit a list of at least five (5) other similar projects that are in operation in the last three (3) years using one of the above coating systems.
 - d. Seismic Performance: Cells shall safely withstand an acceleration, S_s , equal to 300 percent of gravity. Submit engineering calculations to confirm that cells meet this requirement.
 - e. **State Modular Product Compliance:** DCM shall submit the following licensing information from the State of North Carolina:
 - 1) Copy of current licensing as a manufacturer to supply modular products to projects within the state.
 - 2) Copy of current licensing for a manufacturer's representative to sell modular products to projects within the state.
 - 3) Copy of current licensing for an approved inspection agency to provide plan review and approval, evaluation, and inspection services at the point of manufacture to ensure that cell module units are in full compliance with the provisions of the North Carolina Building Code; Volume VIII Modular Construction Regulations.
 - 4) A separate manufacturer's license shall be required for each manufacturing facility operated by a manufacturer, and at least one manufacturer's representative license shall be issued for each location.
 - f. DCM shall submit in writing compliance to the following schedule:

- 1) Submittal package of shop drawings shall be submitted 2 weeks after Notice to Proceed is received by the DCM. (Should be 3 weeks after receipt of executed Purchase Order.)
- 2) Delivery of the cells shall commence on a mutually agreed upon schedule.
- 3) All cells shall be manufactured and shipped to the jobsite on a mutually agreed upon schedule.
- 4) The cell manufacturer shall have their cells installed only by a pre-qualified Detention Equipment Contractor (DEC). Failure to follow this requirement with the bid will be ample reason for disqualification.

1.2 SUMMARY

- A. The Steel Detention Cell Manufacturer (DCM) shall provide the following and as indicated in PART 3 - DIVISION OF RESPONSIBILITY.
 1. Security Frames.
 2. Electrical and Lighting.
 3. Plumbing Fixtures.
 4. HVAC Grilles.
 5. Furnishings.
- B. Related Sections include the following:
 1. Division 03 Section "Cast In Place Concrete."
 2. Division 05 Section "Metal Fabrications" for bar gratings, grating frames and supports.
 3. Division 07 Section "Joint Sealants" for security sealant requirements for cell modules.
 4. Division 09 Section "Paints" for field painting detention cell modules.
 5. Division 11 Section "Detention Equipment" for general requirements for detention work.
 6. Division 11 Section "Custom / Security Hollow Metal Work."
 7. Division 11 Section "Security Glass and Glazing" for glazing in detention cell modules.
 8. Division 11 Section "Security Hardware" for door hardware for detention doors.
 9. Divisions 22, 23 and 26 for plumbing, fire protection, HVAC and electrical.

1.3 APPROVED MANUFACTURERS

- A. Only **Prequalified Manufacturers** are allowed to bid this section. The substitution of other manufacturers will not be acceptable. Subject to compliance with requirements, manufacturers who have met the minimum pre-qualifications include:
 1. Steel Cell of North America; Cornelia, GA.
 2. Maximum Security Systems, Inc.; Penrose, CO.
 3. Coastal Detention Holdings, LLC dba Trussbilt, LLC; Huron, SD.
 4. Approved Equal.
- B. Qualifications of other manufacturers:
 1. To prequalify, firms must submit in writing, no later than 14 business days before the bid, the pre-qualification package which must include the following:
 - a. A list of 20 (minimum) other similar projects, of which 5 projects are currently in operation.
 - b. DCM must have a minimum of 10 years documented experience in the detention industry. DCM to provide experience documentation.
 - c. Manufacturer must certify that the cells will be manufactured entirely of galvanized or galvanized steel or powder coated steel plate to prevent the likelihood of deterioration or rust. DCM must submit mill certifications as proof.
 - d. Provide North Carolina State modular building approval which allows manufacturer to supply modular products within in the state. Refer to paragraph 1.2.A.2.e for full licensing requirements.
 - e. Provide names and phone numbers for all of the DCM's security applications customers for the past 5 years.
 - f. A notarized statement from the Owner or President listing the products that will be used. NO exceptions to this Bill of Materials shall be accepted after the awarding of the contract. Multiple selections are unacceptable. State in writing the intent to "comply fully with the requirements of this specification and to hold harmless the Architect, Engineer, and the Owner from omissions of a casual nature that would be considered to be an implied requirement for a fully

- operational modular cell system." Provide a list of compliance to and non-compliance for each section and subsection of this specification and an explanation of compliance/non-compliance for each section of this specification. Compliance/Non-compliance must be a formal listing of each section and subsection of this specification and an explanation of compliance/non-compliance for each section and subsection.
- g. A list of all outstanding or past judgments or lawsuits against the company Owners, under their current name, or any previous name or business entity.
 - h. Design Engineering Capability:
 - 1) The Steel Detention Cell producer must have current design engineering capability to provide the final engineered structural design for modular steel cells and associated items and their integration into the building construction.
 - 2) Submit a list of design engineering staff, or contractor, giving name, discipline, degree and registrations or licenses, number of years' experience, years with the company, and title or position.
 - 3) Submit a list of technical support personnel for design engineering.
 - 4) Submit samples of design engineering systems (or samples of previous projects) either in AutoCad, or other equivalent engineering programs, in order to determine engineering capability.
 - i. In-House Production Engineering Capability:
 - 1) The Steel Detention Cell manufacturer must have current, in-house production management, with at least ten (10) years of cell experience, capable of understanding design engineering documentation and managing the fabrication and erection process to produce the modular steel cells as engineered.
 - 2) Submit a list of key in-house production management staff giving name, credentials, number of years' experience, number of years with company, and title.
 - j. Production Capability:
 - 1) The Steel Detention Cell manufacturer must have the production capacity and resources to produce the required number of units within a duration of production which is compatible with the construction schedule.
 - 2) Submit name, location, historic production rate and annual production capacity of the plant, and the total number of units produced and in the field.
 - 3) Submit the estimated quantity of work under contract and either scheduled or anticipated for the production facilities proposed for the time period of this project. List by project and estimated production dates.
 - k. Performance Characteristics:
 - 1) Impact resistance: Third party certification of test results for compliance with the following:
 - a) ASTM F2322-12; Physical Assault on Vertical Fixed Barriers for Detention and Correctional Facilities.
 - b) ASTM F1450-12a; Hollow Metal Swinging Door Assemblies for Detention Facilities.
 - 2) Paint Performance: Submit testing of coating system (polyurea or powder coat) that complies with the performance requirements as outlined in the "FINISH" portion of this specification.
 - l. DCM must submit a list of at least 5 other similar projects in the last 3 years using one of the specified coating systems to confirm experience.
 - 1) DCM shall submit testing data to confirm compliance with the performance characteristics noted herein.
 - 2) DCM shall submit coated wall section sample for review and testing.
 - m. Seismic Performance: Cells shall safely withstand an acceleration, S_s , equal to 300 percent of gravity. Submit engineering calculations to confirm that cells meet this requirement.

1.4 ACTION SUBMITTALS

- A. General: Submit the following according to conditions of Contract and Division 01 Specifications Sections.
- B. Product data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
- C. Submittal drawings prepared by or under supervision of a qualified licensed professional, showing complete design information for fabrication and installation of Steel Detention Cell units. Indicate cell dimensions, cross-section, elevations, material specifications, and installation details. Coordinate shop drawings with other trades to ensure compatibility of required service connections.
- D. Submit drawings of recommended bearing pads and/or special anchoring devices.
- E. Provide shipping, lifting and handling diagrams indicating point loads and net and gross loads.
- F. Provide catalog data with full performance criteria and dimension for components purchased from outside sources.
- G. Submit color samples for review and selection by the Owner. Submit samples of the cell finish, color, and texture.
- H. Submit current modular product licensing information from the State of North Carolina. Refer to paragraph 1.2.A.2.e.

1.5 WARRANTIES

- A. Provide special project warranty signed by the DCM, Installer, and Contractor agreeing to repair defective materials and workmanship of the Steel Detention Cell, installation, and related work. The cell warranty shall be conditional upon normal use of the cells. Abuse, such as riots are not considered normal use. The Warranty shall be for a period of one (1) year after substantial completion.

PART 2 - PRODUCTS

2.1 ENGINEERING AND DESIGN

- A. The DCM shall provide Professional certification for the design of the Steel Detention Cells to support superimposed dead loads and live loads as indicated on the contract drawings. The DCM shall certify the design for compliance with applicable governing Code and local Seismic requirements.
- B. The design shall include integration of Steel Detention Cells into the physical floor plan, sections, elevations, and structural design of the facility and shall assure that all systems specified in the contract documents are interfaced completely with Steel Detention Cells for a fully installed, fully working facility.

2.2 WORKMANSHIP

- A. All units shall be tightly fitted and securely fastened with no through seams or cracks.
- B. All panels and assemblies shall be inspected for correct dimensions, joint configuration, straightness, plumb and square.
- C. All exposed edges shall be chamfered or bent for finger contact.
- D. Out-to-out length, width and height dimensions of individual cell units shall be a tolerance of +/- 1/4 inch. The cumulative tolerance in any direction shall not exceed the available horizontal or vertical dimension for the entire assembly of cell units.
- E. All panel joints, ceiling joints, and cell corner joints exceeding 1/16 in. wide and 1/8 in. deep shall be filled with high strength epoxy caulk.
- F. Joints to be welded shall be cleaned and prepared as necessary to assure quality welds.
- G. Welding shall be controlled and sequenced to reduce warpage and distortion.
- H. All welds shall be free of deleterious porosity, pinholes, and cracks.
- I. Finished welds shall be smooth, weld spatter, and flux shall be removed.

2.3 STRUCTURAL COMPONENTS

- A. Framing, floors, walls, and ceilings, as required, shall be constructed of steel shapes, tubing, stiffened plates, cold-formed sections, and/or sheets stiffened with formed sections from steels conforming to design requirements to provide adequate structural strength including the ability to support loading as specified.
- B. All walls and ceiling face panels shall be 0.100 in. (12 gage) minimum thickness A-60 galvanized steel conforming to ASTM A 653-CS requirements or 3/16-inch steel plate. All structural or stiffening members shall be 0.058 in. (16 gage) minimum thickness A-60 galvanized steel conforming to ASTM A 653-LFQ requirements. All structural tubing shall be 0.115 in. (11 gage) minimum thickness steel conforming to ASTM A 653-CS and ASTM A-525, G-90 galvanized requirements.
- C. All welders shall be certified to, and all welding shall be in conformance with, the ANSI/AWS D1.1, Structural Welding Code - Steel and/or ANSI/AWS D1.3, Structural Welding Code - Sheet Steel, as applicable.
- D. Tamper resistant fasteners shall be used for all exposed fasteners where required for accessories.
- E. Mounting and bearing pads, anchorage's, shims, or spacers, shall be manufactured of stainless steel.
- F. Walls must satisfy the following performance requirements:
- G. Wall load tests: Test wall panels using ASTM F2322-12 Standard Test Methods for Physical Assault on Fixed Barriers for Detention and Correctional Facilities. Damage that enables forcible egress constitutes failure. Duplicate 8 ft. high by 8 ft. wide cell wall panels supported four sides in each half of the wall frame illustrated in ASTM F2322-12 Figure 1 and Figure 2. Deliver the following series of impacts:
 - 1. Test Wall-Solid Half (center vertical joint where applicable): Deliver 600 blows at mid-height on the vertical joint (where applicable), 600 blows at mid-height in the center of one panel, and 600 blows at any opening (where applicable).
 - 2. Test Wall-Half with Exterior Window: Deliver 600 blows at center of window frame sill.
- H. Provide weld plates at front and rear of cells for attachment of mezzanine framing and chase framing. Design cell capable of withstanding loads imposed by mezzanine and rear chase catwalk.

2.4 DOORS AND FRAMES

- A. All door and frame construction shall be in accordance with Division 11 Section "Custom/Security Hollow Metal Work."
- B. Glass and Glazing:
 - 1. All glass utilized in the Steel Detention Cell doors shall be as scheduled in the Detention Door Schedule and shall be provided by the DEC. Provide plywood in all security door openings.
 - 2. Frames and doors shall be installed in prefabricated steel cells by the DCM.

2.5 ELECTRICAL

- A. The DCM shall provide the light fixture for the Steel Detention Cell.
- B. Light Fixture:
 - 1. The light fixture shall be equal to a Kenall SDSA-4-0/0-45L50K-120-1/9-1-DLN or as specified, with LED lamps and one (1) LED night light and shall be surface type. The housing shall be 14-gauge steel. The frame shall be 14 gauge with 0.250 polycarbonate and 0.125 prismatic acrylic overlay. The finish shall be baked-on white enamel. All fixtures will provide a minimum of 20-foot candles of light at the desk and the mirror per ACA standards.
 - 2. The DCM shall provide a wiring whip from the cell light to a junction box at the cell mechanical chase.
- C. The DCM shall provide conduit terminated at the mechanical chase for other electrical cell equipment, including, but not limited to, security devices.

- D. The Division 26 contractor shall make all permanent connections from the termination point at the cell mechanical chase.
- 2.6 PLUMBING
- A. The DCM shall provide and install the plumbing fixtures and valve mounting plates for the Steel Detention Cell. The DCM shall supply the water valves, flush valves for the plumbing fixtures separate and uninstalled. The valves shall be installed by the Division 22 Sub-contractor.
 - B. Water-closet and Lavatory Plumbing Fixtures:
 - 1. Water-closet/Lavatory Combination Unit (where indicated on Drawings): Unit shall be PWA-1. Refer to Drawings for detention toilet accessories.
 - 2. Barrier Free Water-closet/Lavatory Combination Unit (where indicated on Drawings): Unit shall be PWA-2. Refer to Drawings for detention toilet accessories.
 - C. The flush valves for the water closets and, the water control manifolds for the lavatories and showers, p-traps, pinned cleanout plugs and other plumbing accessories for the plumbing fixtures shall be provided by the DCM separately and installed by the Division 22 Sub-contractor.
- 2.7 HVAC
- A. Each Steel Detention Cell shall be designed, manufactured, and equipped to receive the required HVAC fixtures specified in other Divisions of this specification.
 - B. The DCM shall provide the HVAC grilles. The grilles shall be pre-punched into the wall panel in compliance and coordinated with the specified Mechanical CFM requirements. Provide extended flange suitable for the connection of the HVAC duct.
- 2.8 THERMAL AND ACOUSTICAL INSULATION
- A. Insulation Material: Materials shall be Sprayed Foam, approved by the applicable codes of NFPA and governing authorities to provide the required thermal and acoustical performance.
 - B. Cell Thermal Insulation: Walls, floors, and ceilings shall be insulated to an R-value of no less than 3.3 R's per inch.
 - C. Acoustical Insulation: The walls between cells and adjacent cells shall have a Sound Transmission Classification (STC) of 53. Cell Fronts shall have a STC of 35. Back of cells to rear mechanical chase and front chase walls to mechanical chase shall have a STC of 40. Provide ignition barrier.
 - D. Ignition Barrier: Provide open-cell foam insulation manufacturer's recommended ignition barrier material; either a water-based intumescent coating or alternate material acceptable to manufacturer and included in current Evaluation Service Report
- 2.9 FURNISHINGS, AND ACCESSORIES
- A. Steel Detention Cell Furniture: Where shown on the contract drawings as cell furniture to be so provided, the DCM shall provide and install wall mounted bunks, tables and stools. Bunks, tables, and stools shall be fabricated of ASTM 653 steel ASTM 525 grade A60 galvanized, 0.100 inch (2.7mm) minimum thickness and of the sizes shown. DCM shall include drawings which detail materials, construction, and attachment. These drawings shall be a part of the submittals as outlined in Section 1.5 herein. Fabrication of these items shall not begin prior to the Architect's approval.
 - B. Fixtures, Furnishings and Accessories Load Test: Reinforce walls, stiffen furnishings, and provide connections as required to support dead loads plus single point (concentrated) static live loads as indicated, at maximum distance on each from wall and from supports for each of the following in accordance with the ASTM draft standard test method for wall mounted steel bunks, seats, and tables used in detention and correctional facilities.
 - 1. Top impact test.
 - 2. Static force test.
 - 3. Cantilever load test.
 - 4. Uplift load test.
 - 5. Wall mounted lavatory - 1000 lbf (4.45 kN)

- C. All security hardware, and associated wiring, shall be supplied and installed by others. This includes, but is not limited to, the following:
 - 1. Cell Door and Pass Locks or Slider Devices.
 - 2. Cell Door Position Switches.
 - 3. Cell Door and Pass Hinges.
 - 4. Cell Intercoms.
 - 5. Cell Surveillance Cameras.
- 2.10 AUTOMATIC FIRE PROTECTION SYSTEMS
- A. The DCM shall provide a prepared location for the installation of the sprinkler head by the fire protection contractor.
 - B. The DCM and fire protection contractor shall coordinate to confirm the type and location of the sprinkler head to ensure the proper interface of work.
 - C. The DCM shall provide a "chase" through top of lower cell to run fire protection piping.

2.11 FINISH

- A. Use one (1) of the following coating systems:
 - 1. **Powder Coating System:**
 - a. The Society for Protective Coatings Specifications SSPC-SP10 Near White Blast Clean, with 1.2 mils to 2.5 mils blast profile is utilized for interior of cell, cleaning prior to paint applied. Blasting is the required means of obtaining a clean surface suitable for application of epoxy.
 - b. Painting: All cell interior steel wall and ceiling assemblies shall be finish coated on all exposed surfaces with Powder Coat Finish Coating. The coatings shall meet these criteria as a minimum:
 - c. Generic: Polyester Based Powder Coat:
 - 1) General Description: A high performance, weatherable, multi- purpose, surface tolerant, coating for industrial or high performance architectural coating (HIPAC) applications. Polyester Based Powder Coatings possess outstanding over bake resistance, exterior exposure qualities, and excellent performance characteristics and mechanical properties.
 - 2) Typical Uses: Applications include sports and recreation equipment, outdoor furniture, fence, automotive and marine aftermarket parts, architectural, lawn and garden implements, institutional and detention furnishings, and various other products and materials requiring long lasting durable protective coatings.
 - 3) Application Conditions: All oil and grease, mill scale and rust, must be removed. Iron or Zinc Phosphate pretreatment is recommended for optimal performance.
 - d. Cure Schedule F/MIN: 400 F/10 MIN
 - 1) Application Method: Electrostatic Spray
 - 2) Recommended Dry Film Thickness: 1.8 – 2.2
 - 3) Powder Properties:

Property	Test Method	Results
Specific Gravity	Calculated	1.63
Square Foot Coverage (ft ² /lb/mil:	Calculated	117.97
60 Degree Gloss:	ASTM D523	90+

- 4) Typical Performance Characteristics:

Pencil Hardness/Mar:	ASTM D3363	2H
Pencil Hardness/Gouge:	ASTM D3363	6H
Cross Hatch Adhesion:	ASTM D3359	5B
Salt Spray Resistance:	ASTM B117	3000+ hours - 1/8-inch "x" scribe

Impact Resistance:	ASTM D2794	140
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2. Polyurea Elastomer Coating System:

a. Prior to application of coatings, all surfaces shall be cleaned and prepared in accordance with SSPC-SP1, SP6, or SP7 as required or as specified by the coating manufacturer.

b. All interior steel surfaces of the Steel Detention Cell shall be prime coated with a Polyurea Elastomer 26 mils to 36 mils dft. The coating shall be certified to ASTM E84, Class II for surface burning characteristics and shall meet or exceed the following:

Adhesion to galvannealed steel:	ASTM D4541	850 psi
Tensile Strength:	ASTM D638	3000 psi
Elongation:	ASTM D638	425 percent
Hardness:	ASTM D2240	Shore D-51
Tear Strength:		450-550 pli
Abrasion Resistance:	ASTM D4060	1000g @ 1000 cycles CS-17 (6 mg loss)

c. All cell interior steel surfaces shall be finish coated for UV protection with a Polyester Urethane Enamel, 3 mils to 4 mils DFT, and shall meet or exceed the following:

Abrasion Resistance:	ASTM D4060	145 mg loss
Weathering:	ASTM D4587	3000 hrs Accelerated
Direct Impact:	ASTM 2794	160 in lbs.
Pencil Hardness:	ASTM D3363	2H

d. The exterior of the cell fronts and cell door along with the cover plates shall be prime painted only with a Catalyzed Epoxy 3 mils to 4 mils DFT, and shall meet or exceed the following:

Adhesion:	ASTM D4541	500 psi
Corrosion Weathering:	ASTM D5894	3360 hours
Direct Impact Resistance:	ASTM D2794	> 140 in. lbs.
Moisture Condensation:	ASTM D4585	100F, 1250 hrs
Salt Fog Resistance:	ASTM B117	1250 hrs, Passes

1) Finish painting of these items shall be completed by the General Contractor.

B. Steel Detention Cells shall be of a single color as selected by the Owner from samples submitted by the manufacturer. Available colors shall be included with cell product data Submittals.

PART 3 – DIVISION OF RESPONSIBILITY, DELIVERY AND INSTALLATION

3.1 DIVISION OF RESPONSIBILITY

A. By DCM

1. Engineer, design, fabricate, transport, deliver for erection by others, prefabricated steel cells and group shower units as required for a complete installation. Provide products, systems, and system components of other related Sections for complete functionally operational prefabricated steel cell units.

a. Cells shall be 5 sided modular units with integral cell front, side and rear walls and ceiling.

2. Provide for any structural components for support of work. Provide all hardware for structurally anchoring and attaching prefabricated steel cell units.

3. Provide all joint sealants and security sealants for this scope of work. Caulk all interior joints, cell furniture, mirrors, plumbing fixtures, detention window and door frames, detention window glazing. Joint between cell bottom and floor shall be caulked by the Division 07 contractor.

4. Provide hollow metal framed opening, hardware preparation and in wall support for detention hollow metal doors.
 5. Provide high build coating system of finishes of steel components and cell interiors.
 6. Provide detention furnishings, equipment and accessories for wall mounted furnishings including the writing surface, stools, bunks, one-piece mirrors, grab bar, security fasteners and security bolts.
 7. Furnish cell units with plumbing fixtures and provide for drains, and pipes. Fixtures to be stainless steel combination lavatory/water closet for standard cells and barrier free stainless-steel combination lavatory/water closet for handicap accessible. Provide carriers and flush valves for water closets and hot and cold valves for lavatory.
 8. Provide security air distribution supply and return grilles, finish painted.
 9. Provide electrical conduit, fittings, conductors, and security light fixtures. Provide 1-foot-0-inch x 4-foot-0-inch LED light fixture with LED night-light in each cell. Provide back box inside cell and conduit to junction box in chase for inmate intercom station with pull string. Provide wiring for light fixtures, terminated at fixture, and pulled to junction box in rear cell chase with 18-inch pigtail and tagged for identification.
 10. Provide block out for sprinkler head in cell.
 11. Provide an acceptable quality control program that complies with the state modular program.
 12. Caulk/grouting of the cells to the slab and upper to lower cell shall be completed by Division 07 contractor.
 13. Steel plates to cover joints between cells and between cells and different construction.
 14. **Provide manufacturer's certification label for North Carolina on all cell module units.**
- B. Items Not By DCM
1. On-site Mechanical, Plumbing, and Electrical connections to the cells.
 2. Painting exterior of cell surfaces.
- 3.2 DELIVERY SEQUENCING AND SCHEDULING
- A. The General Contractor shall provide the DCM a proposed schedule of cell delivery and installation sequence before the project bid date in order for the DCM to properly bid the installation of the cells.
 - B. The General Contractor and DCM shall coordinate the scheduling of cell delivery to the project site. A mutually approved schedule shall be determined by the General Contractor and DCM at the pre-construction meeting. The sequencing of the cell units shall conform to this schedule to properly interface the delivery and installation of cells at the proper time during the construction period.
 - C. DCM shall deliver Steel Detention Cells to the designated project site, properly protected from shipping damage. The General Contractor shall provide suitable protective coverings, devices or such methods and procedures to protect the cells from damage from the weather or vandalism. Protective measures shall remain throughout the construction period. Unloading and handling of the cell units shall be the responsibility of the cell installer. Final cell door adjustments shall be completed by the installer.
- 3.3 SITE INSPECTION
- A. The installer of the Steel Detention Cells shall examine areas and conditions under which the units are to be installed. The installer is to notify the contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- 3.4 INSTALLATION
- A. The General Contractor shall provide the DEC (Detention Equipment Contactor) and the DCM a proposed schedule of cell delivery and installation sequence before the project bid date in order for the DCM to properly bid the installation of the cells.
 - B. The DEC shall be a pre-qualified and certified cell installer to install the Steel Detention Cells. The DCM shall provide a qualified on-site representative for initial cell installation to verify proper cell offloading and installation procedures.

- C. The General Contractor shall provide adequate access for the DCM's tractor-trailer transport trucks and the cell installer's installation equipment. This access shall be suitable for the DCM's trucks, and the DEC's installation equipment to maneuver under their own power.
- D. The General Contractor shall provide adequate space and maneuvering room to install the cells. There shall be no barriers or work of others that restrict or prevent the adequate movement of the cells or the installer's installation equipment.
- E. Steel Detention Cells shall be set in place by the DEC and shall be checked for correct alignment and level. Shims shall be installed as necessary and securely fastened to the foundation. Complete all connections, trim, and touch up, meeting the acceptable industry standards and manufacturer's recommendations. Provide mortar setting bed at low spots in the slab and foundation.
- F. The DEC shall install cell to cell trim plates (12 GA MIN), provided by the DCM to cover the joint between the cells. All other joints are to be trimmed by others.
- G. The General Contractor shall provide for the protection of the Steel Detention Cell's from the weather, misuse or abuse from the other trades, and vandalism once the cells are delivered and installed.
- H. Fill all voids between the bottom of the cell walls and the floor with security caulk (and backer rod if required).

END OF SECTION 134263.16

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors.
- C. Exposed, Exterior Installations: Exposed to view outdoors.
- D. Subject to Freezing: Subject to temperatures below 40 degrees F.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by occupants.
- F. Concealed, Exterior Installations: Concealed from view and protected from physical contact by occupants.
- G. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the International Mechanical Code shall be listed and labeled in accordance with the current edition of the North Carolina Building Code.
- B. Equipment and appliances comprising portions of the fire suppression systems regulated by the NFPA 13 shall be installed in accordance with the listing and the manufacturer's installation instructions. Manufacturer's installation instructions shall be available on the job site for use and inspection.

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- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Fire-suppression piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.5 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.6 INTENT OF CONTRACT DOCUMENTS

- A. Fire Suppression/Protection drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

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PART 2 - PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match fire-suppression piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180°F.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.]

2.2 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 JOINING MATERIALS

- A. Pipe Joint Compound for Threaded Pipe: UL listed.

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2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around fire-suppression piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

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PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install fire-suppression piping according to the following requirements and Division 21 Sections specifying fire-suppression piping systems.
- B. Install fire-suppression piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install fire-suppression piping indicated to be exposed and fire-suppression piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Diagonal runs are permitted in the attic spaces.
- D. Install fire-suppression piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install fire-suppression piping to permit valve servicing.
- F. Install fire-suppression piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Fire-suppression piping:
 - a. Fire-suppression piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Fire-suppression piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Fire-suppression piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Fire-suppression piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Fire-suppression piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Fire-suppression piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Fire-suppression piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Fire-suppression piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- J. Sleeves are not required for core-drilled holes through solid concrete walls and floors.
- K. Sleeves are required in all interior partitions.
- L. Permanent sleeves are not required for holes formed by removable PE sleeves.

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- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.

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- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 FIRE-SUPPRESSION PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying fire-suppression piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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 pipe joint compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Grooved Joints: Assemble joints with listed coupling, gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Roll-groove piping. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Fire-suppression piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Fire-suppression piping: Join according to ASTM D 2846/D 2846M Appendix.
- I. Plastic Pressure Fire-suppression piping Gasketed Joints: Join according to ASTM D 3139.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

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2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

- A. Mix and install grout for fire suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.6 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
 1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below minimum depth of cover based on locality or 1'-0" below frost line whichever is lower.
 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.

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3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve-inch lifts.

END OF SECTION 210500

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SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Description of Work:

1. The work includes designing and providing an automatic sprinkler system of required hazard for building occupancy to afford complete fire protection coverage throughout. Where required the work shall include complete standpipe systems. The design, equipment, materials, installation and workmanship shall be in strict accordance with the Owners insurance underwriter's requirements, the North Carolina Construction Code, and the required and advisory provisions of NFPA.
2. Unless otherwise indicated piping shall not be run in spaces containing electrical equipment in the form of transformers, panel-boards, switchgear, or computer servers.
 - a. Exceptions:
 - 1) Personal computers (PC,s)
 - 2) Spaces whose name does not include the term "Electrical", "Data", or "Computer"
3. Each system shall include materials, accessories and equipment necessary to provide each system complete and ready for use.
4. The design of each system shall give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage.
5. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc., or approved by the Factory Mutual System.
6. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.
7. Reference to the "authority having jurisdiction" shall be interpreted to mean the Local Fire Marshal..
8. Calculations shall include delivering water from the point of the fire hydrant flow test through the site piping.

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9. Consideration shall be given to all unheated areas such as attics, utility rooms, loading docks, outdoor storage spaces with canopies, etc., to provide freeze protection in accordance with NFPA 13. This shall include the installation of dry sprinklers, anti-freeze, and dry-pipe sprinkler systems where necessary.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.
- C. Preaction Sprinkler System: Automatic sprinklers are attached to piping containing air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

1.4 PERFORMANCE REQUIREMENTS

- A. Component Working Pressure: Listed for at least 175 psig.
- B. Design shall be approved by authorities having jurisdiction.
- C. Fire-suppression sprinkler system design shall include the following:
 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 2. Sprinkler Occupancy Hazard Classifications shall be as indicated on the drawings. If not indicated comply with NFPA 13.
 3. Maximum Protection Area per Sprinkler shall be in accordance with its UL listing.
- D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- E. Seismic Performance for category C thru F: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Piping materials, flexible connections, and sprinkler specialty fittings.
 2. Pipe hangers and supports.

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3. Valves, including listed fire-protection valves, unlisted general-duty valves, specialty valves and trim.
 4. Air compressors, including electrical data.
 5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 6. Alarm devices, including electrical data.
- B. Fire-hydrant flow test report.
- C. Approved Sprinkler Piping Shop Drawings: Working plans, prepared according to NFPA 13, including hydraulic calculations. Diagram power, signal, and control wiring.
1. Include shop drawings indicating location of all sprinkler heads and all other construction that penetrates ceilings, including light fixtures, HVAC equipment, speakers, fire alarm devices, partition assemblies, etc.
- D. Welding certificates.
- E. Operation and Maintenance Data to include in emergency, operation, and maintenance manuals.

1.6 CLOSEOUT SUBMITTALS

- A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. A Professional Engineer registered in the state where the project is constructed shall stamp and seal the Shop Drawings.
- B. Flow test:
1. Bid shall be based on the indicated fire-hydrant flow and pressure.
 2. Design calculations shall be based on the results of a confirming fire-hydrant flow test performed or caused to be performed by the contractor.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

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1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.
 2. Any couplings requiring a torque wrench, per manufacturer installation instruction, must have a test tag attached to each bolt showing torque used for each. Tags shall be date stamped and initialed by the installer.
- E. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13: "Installation of Sprinkler Systems." applicable edition.

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 SPRINKLER CABINET(S) AND SPARE SPRINKLERS

- A. Provide finished, wall-mounted, steel sprinkler cabinet with hinged cover.
- B. Provide space for minimum of six spare sprinklers and sprinkler wrench.
- C. Provide minimum of six spare sprinklers and sprinkler wrench in cabinet.
- D. Provide number of sprinklers required by NFPA 13.
- E. Provide separate cabinet with sprinklers and wrench for each type of sprinkler on Project.
- F. Provide products packaged with protective covering for storage. Identify contents with label.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 1. Mechanical-Joint, Ductile-Iron Fittings AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 1. Push-on-Joint, Ductile-Iron Fittings AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

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2. Gaskets: AWWA C111, rubber.
- C. Grooved-End, Ductile-Iron Pipe: AWWA C151, with factory- or field-formed, radius-cut-grooved ends according to AWWA C606.
 1. Grooved-Joint Piping Systems:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company: FireLock or engineer approved equal.
 - b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD.
 - c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts. Basis of Design: Victaulic Style 31.
 - d. Grooved-End-Pipe Transition Coupling: UL 213 and AWWA C606, gasketed fitting with end matching ductile-iron-pipe OD and end matching steel-pipe OD. Include ductile-iron housing with key matching ductile-iron-pipe groove and key matching steel-pipe groove, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts. Basis of Design: Victaulic Style 307.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or shop-formed threaded or grooved ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized where indicated.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.
 1. Grooved-Joint Piping Systems:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company: FireLock or engineer approved equal.

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- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD. In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Victaulic FireLock.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and ASTM A449 compliant steel bolts and nuts.
 - 1) Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
 - a) Installation Ready™ rigid single-bolt coupling, Victaulic Style 109, in sizes NPS 1-1/4 (DN32) through NPS 2-1/2 (DN65).
 - 2) Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
 - 3) Installation ready gaskets are center-leg, with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
 - d. Installation-Ready™ fittings for Schedule [40] [10] grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½ (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, [orange enamel coated] [red enamel coated] [galvanized]. Fittings complete with prelubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
 - 1) Victaulic FireLock IGS System with “Installation-Ready™ fittings and couplings may be used for NPS 1 (DN 25) Schedule 10 and Schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kPa).
 - 2) Groove: IGS “Innovative Groove System” groove with shortened “A” dimension and tapered groove backside for ease of installation.
 - 3) Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.
- D. Grooved-End, Schedule 10 Steel Pipe: Schedule 10 in NPS 2-1/2 to NPS 5; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.
- 1. Grooved-Joint Piping Systems:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company: FireLock or engineer approved equal

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- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD. In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Victaulic FireLock.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and ASTM A449 compliant steel bolts and nuts.
 - 1) Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
 - a) Installation Ready™ rigid single-bolt coupling, Victaulic Style 109, for sizes [cULus, FM], in sizes NPS 1-1/4 (DN32) through NPS 2-1/2 (DN65) sizes.
 - 2) Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
 - 3) Installation ready gaskets are center-leg, with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
- d. Installation-Ready™ fittings for Schedule [40] [10] grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½ (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, [orange enamel coated] [red enamel coated] [galvanized]. Fittings complete with prelubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
 - 1) Victaulic FireLock IGS System with “Installation-Ready™ fittings and couplings may be used for NPS 1 (DN 25) Schedule 10 and Schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kPa).
 - 2) Groove: IGS “Innovative Groove System” groove with shortened “A” dimension and tapered groove backside for ease of installation.
- e. In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System [with captured coupling Style 108] may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
 - 2. The drop shall include a UL approved Series AH1 with 3” bend radius; AH2 or AH2-CC braided hose with a bend radius to 2” to allow for proper installation in confined spaces.
 - 3. Union joints shall be provided for ease of installation.

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4. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place.

- 1) Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.

2.3 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.4 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
 1. NPS 2 and Smaller: Threaded or grooved.
 2. NPS 2-1/2 and Larger: Flanged or grooved.
 3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- C. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.5 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have
- B. Outlet Specialty Fittings:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and grooved outlets. Basis of design Victaulic style 920/920N and style 922.
 3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded or grooved or grooved outlet. Basis of design Victaulic style 923.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded, grooved or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal

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2.6 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal.
 - 2. NPS 1-1/2 and Smaller: Bronze or brass body with threaded or grooved ends. Basis of Design: Victaulic Series 728.
 - 3. NPS 2 and NPS 2-1/2: Ductile-iron body with grooved ends.
 - 4. NPS 3: Ductile-iron body with grooved ends.
- C. OS&Y Gate Valves: UL 262.
 - 1. Ductile-iron body with flanged x Groove or groove x groove ends. No Flange x Flange will be accepted.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal. Basis of design Victaulic model 771H or 771F.
- D. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with grooved ends.
 - a. Manufacturer Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends. Valve seat shall be pressure-responsive, and the stem offset from the disc centerline to provide complete 360-degree circumferential seating. Basis of Design: Victaulic Series 705. Each valve must be individually tested at factory to include electronics.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- E. Check Valves NPS 2 and Larger: UL 312, spring-assisted swing type for vertical or horizontal installation, cast- ductile iron body with flanged or grooved ends. Basis of Design: Victaulic Series 717.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

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1. Indicator: Weatherproof actuator housing with electrical, 15 amp @125-VAC 60 HZ, prewired, single-pole-single-throw, supervisory switches
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded or grooved or grooved ends. Basis of Design: Victaulic Series 728.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal

G. Double Check Backflow Preventers:

1. Manufacturers including but not limited to: All Backflow preventers must have Grooved ends and utilize Victaulic OS&Y valves.
 - a. Ames Co.
 - b. Conbraco.
 - c. Febco.
 - d. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015
3. Application: continuous-pressure.
4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
5. Size: 3/4" thru 10" as required to match connected piping.
6. Body: Brass or bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. Configuration: As needed for installation.
8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 1/2" and larger.

2.7 GENERAL-DUTY VALVES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- B. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded or grooved or grooved ends.

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- C. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded or grooved ends.

2.8 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 - 2. Riser Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for drain and pressure gages. Basis of Design: Victaulic Series 717R.
 - 3. Floor control valve assemblies: Universal Manifold Check Valve | Model UMC
Model UMC - 1-1/4, 1-1/2, 2, 2-1/2, 3, 4, 6, and 8-inch Universal Manifold Check Valve: Where universal manifold check valves are specified for use in wet-pipe sprinkler systems, as floor control manifolds they shall be specifically listed for such use. Universal manifold check valves shall be ductile iron construction, incorporating a control valve, check valve, flow switch, test & drain assembly, adjustable relief valve, and system gauges in one compact body/footprint, and shall be manufactured for "right" and "left"-hand orientations. The test & drain assemble shall contain an adjustable relief valve, with a range of 175 to 310 psi, and a universal test orifice of K2.8; to provide testing capabilities of systems with k-factors ranging from K2.8 and larger. The Universal Manifold Check valve shall be rated for use at the maximum service pressure of 300 psi and shall be UL listed and FM approved. Universal manifold check valves shall be the Model UMC; as manufactured by Globe brand by Victaulic Company.
 - 4. Dry-Pipe Valves: UL 260, differential type; with bronze seat with O-ring seals, single-hinge pin, and latch design. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment. Basis of design Victaulic series 768N Firelock NXT Dry Valve or Engineer approved equal. Valves must be inside an enclosure with climate control. Basis of design is Victaulic Firelock Fire-Pac series 745 for either wet or dry systems.
 - a. Air-Pressure Maintenance Device: UL 260, automatic device to maintain correct air pressure in piping. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig maximum inlet pressure. Basis of design Victaulic 757.
 - 1) Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal

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- b. Air Compressor: UL 753, fractional horsepower, 120-V ac, 60 Hz, single phase. Basis of design Victaulic 7C7.
 - 1) Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 - C. Nitrogen generator shall be Potter. Nitrogen Generator must be listed with the Dry valve.
 - D. Hydraulic Control valves including but not limited to Pressure control valves, pressure reducing valves, pressure relief valves and level control valves shall all be fire listed. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or Bermad.
 - B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded or grooved ends.
 - 1) Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
 - C. Preaction Valves and Deluge valves: Basis of design Victaulic 769N Firelock NXT. Valves must be inside an enclosure with climate control. Basis of design is Victaulic Firelock Fire-Pac series 745 for either wet or dry systems.
5. NITROGEN GENERATION SYSTEM-Basis of Design: VICTAULIC INS-V SERIES
- A. Potter IntelliGen Nitrogen Generator (INS Series)
 - 1. Furnish and install a nitrogen generator system at each fire sprinkler riser room to service all dry/pre-action zones as required by the system size and pressure requirement stipulated in the drawings and installed per manufacturer's instructions.
 - 2. The nitrogen generator shall have an air compressor that is sized appropriately for the application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA 13.
 - 3. The nitrogen generator shall provide a minimum of 98% purity nitrogen to the fire sprinkler system.
 - 4. The nitrogen generator shall be equipped with a filtration system to remove residual water and all hydrocarbons from the air stream.
 - 5. The nitrogen generator shall have a nitrogen control panel capable of monitoring compressor runtimes, nitrogen generator pressure, and operational mode locally and over the internet.
 - 6. The nitrogen generator shall have a leak detection system capable of determining sprinkler system leak rates and give alerts if leaks develop within the sprinkler piping, nitrogen generator system or air compressor.
 - 7. Alerts shall be capable of being e-mailed.

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8. The nitrogen generator systems shall have the ability to automatically switch between air bypass mode and nitrogen generating mode based on the demands of the sprinkler system.
9. The nitrogen generator shall have an air storage tank and nitrogen storage tank air that confirm to ASME standard for pressure vessel.
10. The nitrogen generator is FM approved.

B. Potter IntelliPurge Nitrogen Purge Valve (INS-PV)

1. Furnish and install a nitrogen purge valve at the furthest point from the fire sprinkler riser for each fire sprinkler riser.
2. The nitrogen purge valve be supplied with a restricted orifice which size is determined by the total system pressure requirements.
3. The nitrogen purge valve shall have a nitrogen sensor that can shut off the purge valve after 98% nitrogen has been achieved throughout the fire sprinkler system.
4. The nitrogen purge valve shall monitor the nitrogen level in the fire protection system periodically.
5. The nitrogen purge valve shall have a BMS alarm relay to indicate trouble if nitrogen purity drops below desired purity.
6. The nitrogen purge valve shall be able to connect to a nitrogen generator for remote monitoring.
7. The nitrogen purge valve shall be able to be networked with other purge valves.
8. The nitrogen purge valve shall be closed during hydrostatic and air pressure testing of the fire sprinkler system and then placed in the open position for the commissioning, treatment and operation of the system.

C. Air Maintenance Device

1. Furnish and install an Air Maintenance Device for each dry or preaction fire sprinkler system.
2. Air Maintenance Device shall be equipped with an adjustable pressure regulator that is capable of setting the required pressure for the fire sprinkler system.
3. The Air Maintenance Device shall be listed or approved for fire sprinkler application.
4. The Air Maintenance Device shall be installed per manufacturer's specifications

D. Supervision and Training

1. A Consulting Services Package for commissioning the nitrogen generator shall be provided by Victaulic. Contact Chris Pickford at 276-285-4205 to schedule commissioning at least 3 weeks in advance. The fire sprinkler contractor shall have Potter Corrosion Solutions assist in final system commissioning. The fire sprin-

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kler contractor shall confirm that all the Potter Nitrogen Generator System connections have been made as specified and as indicated in the manufacturer's installation instructions.

- 1.
- D. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded or grooved ends.
 1. Available Manufacturers:
 - a. Grinnell Fire Protection.
- E. Pressure reducing valves: UL Listed and FM Approved pressure relief valve to prevent over pressure while maintaining a constant preset system pressure regardless of fluctuating demand. Valve shall consist of a grooved, flanged, or threaded end ductile iron body conforming to ASTM A536 with electrostatic powder coated polyester red coating [carbon steel body to ASTM A216] [316 stainless steel body] [Ni-Al-Bronze body to ASTM B148]. Valve internal components shall be reinforced polyisoprene [NBR] [EPDM] elastomer seals. The valve shall have a straight-through Y-type-body with unobstructed flow path, and no stem guide or supporting ribs. Valve actuation shall be accomplished by a fully peripherally supported, one-piece balanced rolling-diaphragm, vulcanized with a rugged radial seal disk. The diaphragm assembly shall be the only moving part. Control trim system shall be 316 stainless steel [brass] [Monel and aluminum-bronze] [Hastelloy C276], with a 2-Way adjustable, pressure relief pilot valve. The valve shall be UL listed and FM approved, 365 psi [2517-kPa] rated, line pressure driven and pilot operated and water operating temperatures to 122°F [50°C]. Basis of design: Victaulic Series 867-43T or Bermad.

UL Listed and FM Approved pressure relief valve to prevent over pressure while maintaining a constant preset system pressure regardless of fluctuating demand. Valve shall consist of a grooved, flanged, or threaded end ductile iron body conforming to ASTM A536 with electrostatic powder coated polyester red coating [carbon steel body to ASTM A216] [316 stainless steel body] [Ni-Al-Bronze body to ASTM B148]. Valve internal components shall be stainless steel, with polyamide fabric reinforced polyisoprene [NBR] [EPDM] elastomer seals. The valve shall have an unobstructed flow path, with no stem guide or supporting ribs. Valve actuation shall be accomplished by a fully peripherally supported, one-piece balanced rolling-diaphragm, vulcanized with a rugged radial seal disk. The diaphragm assembly shall be the only moving part. Control trim system shall be 316 stainless steel [brass] [Monel and aluminum-bronze] [Hastelloy C276] and shall consist of a 2-Way adjustable, pressure relief pilot valve. Valve shall be suitable for working pressure to 175 psi [1200-kPa] and water operating temperatures to 122°F [50°C]. All internal components shall be replaceable without removing the valve from the installed position. Basis of Design: Victaulic Series 867-4UF or Bermad

UL Listed and FM Approved pressure relief valve to reduce higher upstream pressure to lower preset downstream pressure regardless of fluctuating demand or varying upstream pressure. The main valve shall be a center guided, diaphragm actuated globe valve of either oblique (Y) or angle pattern design with an unobstructed flow path, no stem guides, bearings, or supporting ribs. Valve body shall be ductile iron, and include a replaceable, raised, stainless steel seat ring. All external bolts, nuts, and studs shall be Duplex[®] coated. Valve shaft shall be stainless steel, center guided by a bearing in the separating partition. The replaceable radial seal disk shall include a resilient seal. The actuator assembly shall be double chambered with an inherent separating partition between the

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lower surface of the diaphragm and the main valve. All fittings shall be nickel-plated brass or stainless steel. The control system shall consist of a 2-Way adjustable, pressure relief pilot valve. Valve shall be suitable for working pressure to 350 psi [2413-kPa] and water operating temperatures to 122°F [50°C]. All internal components shall be replaceable without removing the valve from the installed position. Basis of Design: Victaulic Series 867-7UF or Bermad.

2.9 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Basis of design Victaulic/Globe.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic Company or engineer approved equal
- C. Automatic Sprinklers: UL-Listed with quick response glass bulb type heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
- D. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.
- E. Sprinkler types, features, and options as follows:
 - 1. Brass upright sprinklers.
 - 2. Extended-coverage sprinklers.
 - 3. Concealed pendent sprinklers, including cover plate.
 - 4. Pendent sprinklers.
 - 5. Pendent, dry-type sprinklers.
 - 6. Quick-response sprinklers.
 - 7. Recessed sprinklers, including escutcheon.
 - 8. Sidewall sprinklers.
 - 9. Sidewall, dry-type sprinklers.
 - 10. Attic sprinkler Globe Brand by Victaulic where applicable.
 - 11. Grooved heads as manufactured by Victaulic.
- 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: 2 piece, with 1-inch vertical adjustment.
 - 2. Sidewall Mounting: 2 piece, with 1-inch horizontal adjustment.
- G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.
- H. In lieu of rigid connections to dry sprinkler heads, a Victaulic VicFlex™ dry sprinkler, Model VS1, may be used. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2" and allow for up to 4 bends.

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- I. For cooler or Freezer boxes: Victaulic AB6 Freezer dry pendant utilizing a flexible hose connection shall be used. No dry Pendant utilizing a rubber boot will be allowed.
- J. For Vestibules: Install Dry type horizontal sidewall sprinklers.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

- 1. Central Sprinkler Corp.
- 2. Elkhart Brass Mfg. Co., Inc.
- 3. Fire-End and Croker Corp.
- 4. Guardian Fire Equipment Incorporated.
- 5. Potter-Roemer; Fire-Protection Div.

- B. Wall-Type, Fire Department Connection: UL 405, 175-psig (1200-kPa) minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

- 1. Type: Flush, with two inlets and square or rectangular escutcheon plate.
- 2. Finish: Chrome plated.

- C. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage to prevent freezing. Basis of Design: Victaulic #10-DR.

2.11 TEST HEADER FOR BACKFLOW PREVENTER

A. Manufacturers:

- 1. Elkhart Brass Mfg. Co., Inc.
- 2. Fire-End and Croker Corp.
- 3. Guardian Fire Equipment Incorporated.
- 4. Potter-Roemer; Fire-Protection Div

B. Hose Valve Manifold Assembly:

- 1. Header Pipe: Schedule 40, steel or ductile iron.
- 2. Header Pipe Fittings: galvanized cast-iron threaded fittings.
- 3. Automatic Drain Valve: UL 1726
- 4. Hose Valves: UL 668, straightway pattern, chrome plated with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header-manifold escutcheon plate.
- 5. Nipples: Schedule 40 galvanized-steel pipe with threaded ends.
- 6. Caps with Chain: Chrome plated with threaded outlet.
- 7. Escutcheon Plate: Chrome plated, rectangular.
- 8. Exposed Parts Finish: Chrome plated.
- 9. Escutcheon Plate Marking: "BKFL TEST CONN"

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2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Wet Pipe Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include 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.
 - 1. Available Manufacturers:
 - a. Grinnell Fire Protection.
 - b. ITT McDonnell & Miller.
 - c. Potter Electric Signal Company.
 - d. Viking Corp.
 - e. Watts Industries, Inc.; Water Products Div.
- C. Dry Pipe Water-Flow Indicator (Pressure Switch): UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
 - 1. Available Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
 - d. Viking Corp.
- D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Available Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
- E. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.
 - 1. Available Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.
- F. Outside Electric Bell: UL 753, 120VAC with weatherproof backbox.
 - 1. Available Manufacturers:
 - a. Notifier
 - b. Potter Electric Signal Company.

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- c. System Sensor.

2.13 PRESSURE GAGES

- A. Available Manufacturers:
 - 1. Dresser Equipment Group; Instrument Div.
- B. Description: UL 393, 3-1/2" to 4-1/2" diameter dial.
- C. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA standards, procedures, appendices, or recommendations.
- B. Report test results no later than two days following the test in writing.

3.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

- A. Provide shop-welded joints where welded is required.
- B. Provide shop or manufacturer-threaded or grooved joints where threads are required.
- C. Field-welded joints will be permitted where indicated on the drawings. Field welding is optional where indicated. Other approved or specified methods are acceptable.

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- D. Do not use welded joints for galvanized-steel.
- E. Flanges, flanged fittings, unions, nipples, transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- F. Underground Piping: Ductile-iron, mechanical-joint pipe and fittings with restrained joints. Include corrosion-protective encasement.

3.5 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. Sprinkler Piping NPS 2" and smaller use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, black, schedule 40 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
 - 2. Sprinkler Piping NPS 2 1/2" and larger use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, black, schedule 10 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and roll grooved joints.
- B. Dry-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. Sprinkler Piping NPS 2" and smaller use any of the following:
 - a. Threaded or grooved-end, galvanized, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, galvanized, schedule 40 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, galvanized, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
 - 2. Sprinkler Piping NPS 2 1/2" and larger use any of the following:
 - a. Threaded or grooved-end, galvanized, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, galvanized, schedule 10 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, galvanized, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and roll grooved joints.

3.6 VALVE APPLICATIONS

- A. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for application.
 - a. Shutoff Duty: Use ball, or butterfly valves.

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3.7 JOINT CONSTRUCTION

- A. Refer to Section "Common Work Results for Fire Suppression" for basic piping joint construction.
- B. Threaded or grooved Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than 8" with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads may be checked by a ring gage and shall comply with ASME B1.20.1.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts in accordance with the manufacturer's published installation instructions.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
 - 4. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 - 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 - 3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.8 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.9 PIPING INSTALLATION

- A. Refer to Section "Common Work Results for Fire Suppression" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, shop drawings, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated.

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1. Deviations from approved working drawings for piping require written approval from authorities having jurisdiction and Architect. File written approval with Architect before deviating.
- C. Install underground piping according to NFPA 13, NFPA 24 and Drawings. Provide restrained joints. Provide corrosion-protective encasement.
- D. Provide approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Provide unions adjacent to each valve in pipes 2" and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Provide flanges or flange adapters on valves, and equipment having 2-1/2" and larger pipe connections.
- G. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- H. Provide "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve. Test connections that discharge to the exterior shall discharge 1'-0" above a concrete splash block. Provide splash block under this section of the specifications. Pipe penetration shall be installed to coursing dimensions where concrete masonry units are utilized to construct wall.
- I. Provide sprinkler piping with drains for complete system drainage.
- J. Provide alarm devices.
- K. Hangers and Supports: Refer to Section "Hangers and Supports for Fire-Suppression Piping" for hanger materials.
 1. Install sprinkler system piping according to NFPA 13.
- L. Earthquake Protection for Seismic Design Category C thru F: Install piping according to NFPA 13 to protect from earthquake damage.
- M. Install pressure gages on each riser or feed main, and at each sprinkler test connection. Include pressure gages with connection not less than 1/4" and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where not subject to freezing.
- N. Drain dry-pipe sprinkler piping.
- O. Pressurize and check dry-pipe sprinkler system piping and air compressors.
- P. Pressurize and check preaction sprinkler system piping and air compressors.
- Q. Fill wet-pipe sprinkler system piping with water.

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3.10 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty 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. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
- D. Install backflow preventer in potable-water supply sources.
- E. Specialty Valves:
 - 1. Riser Check Valves: Install in vertical position for proper direction of flow.
 - 2. Deluge Valves: Install in vertical position, in proper direction of flow, in main supply to preaction system.
 - 3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
 - b. Install air compressor and compressed-air supply piping.

3.11 SPRINKLER APPLICATIONS

- A. Use the following sprinkler types unless otherwise indicated:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Recessed pendent sprinklers.
 - 3. Wall Mounting: Recessed Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Dry pendent sprinklers.
 - 5. Special Applications: Extended-coverage, and quick-response sprinklers where required.
 - 6. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough brass in unfinished spaces not exposed to view.
 - b. Concealed Sprinklers: Rough brass, with factory white painted cover plate.
 - c. Recessed Sprinklers: Chrome plated with matching two-piece escutcheon.

3.12 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in the center of acoustical ceiling panels and tiles.

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- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space wherever possible. Otherwise, use , antifreeze sprinkler systems, or dry-pipe systems.
- C. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.
- D. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

3.13 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping.
- C. Install ball drip valves at each check valve for fire department connection. Drain as indicated. If not indicated otherwise, drain to floor drain or outside building.
- D. Connect piping to hose valves, specialties, fire department connections, and accessories.
- E. Connect compressed-air supply to dry-pipe sprinkler piping.
- F. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire alarm devices, including low-pressure alarm.
- G. Coordinate connection of alarm devices to fire alarm.
- H. Ground equipment. Grounding shall be in accordance with section "Grounding and Bonding for Electrical Systems."
- I. Coordinate connection of wiring.
- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.14 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and "Common Work Results for Fire-Suppression" for piping identifications.

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3.15 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.
 - 4. Start and run air compressors.
 - 5. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 6. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 - 7. Coordinate with fire alarm tests. Operate as required.
 - 8. Coordinate with fire-pump tests. Operate as required.
 - 9. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.16 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Provide sprinklers to replace sprinklers with paint or coating other than the original factory finish.
- C. Protect sprinklers from damage and debris until Substantial Completion.
- D. Protect the building exterior when operating drains and test connections discharging to the building exterior.
- E. Dirt and stains on any surfaces resulting from the work of this section shall be cleaned and removed under this section.

3.17 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the system.

END OF SECTION 211000

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
 2. Dielectric fittings.

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3. Mechanical sleeve seals.
4. Escutcheons.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

- A. Plumbing drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

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- B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.
- D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not shown on the drawings are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

1.8 INSTALLED EXTRA PIPING AND EQUIPMENT

- A. The Plumbing Contractor (PC) shall include in his bid, labor and material for the installation of the following:
 - 1. 5 domestic water backflow prevention devices to serve coffee brewers, tea brewers, ice machines, and other general beverage dispensing equipment.
 - 2. 5 water supply boxes to serve ice making and water dispensing equipment and refrigerators.
 - 3. 5 interior, flush-mounted, loose-key operated, hose bibbs.
- B. Each of these items shall include 30' of ½" domestic water piping, fittings, valves, insulation, and accessories, etc... As needed throughout the project, the A/E or Owner will direct the Plumbing Contractor (PC) where these items are to be installed.
 - 1. There shall be a line item on the plumbing schedule of values titled "Extra Piping and Equipment".
 - 2. At project completion, a credit shall be given to the Owner for all unused extra piping and equipment. It shall be the Plumbing Contractor's responsibility to keep track and record of this work.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to other Division 22 piping sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

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2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping sections for joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

- A. Manufacturer: Victaulic
- B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, 2 bolts and 2 nuts.
- C. Gasket Material: Grade "E" EPDM suitable for use up to 250 degrees F.
- D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

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- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig working pressure, as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

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- E. Molded PE: Reusable, PE, tapered-cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.8 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Fastener: Provide torx-head (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish: Finish shall match that specified of the item anchored.
 - 3. Tools: Provide tools for fastening devices

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PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following and Division 22 Sections specifying piping systems.
- 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 the minimum slopes required by authorities having jurisdiction unless otherwise indicated.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - 2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
 - 3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - 4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
 - 5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
 - 6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
 - 7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
 - 8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below

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- L. Sleeves are not required for core-drilled holes.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

- N. Install sleeves for pipes passing through walls, floors, or roofs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
 - 2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: Permitted for pipes smaller than NPS 6 except aboveground, exterior-walls.
 - b. Steel Sheet Sleeves: Permitted for pipes NPS 6 and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
 - c. Stack Sleeve Fittings: For pipes penetrating floors. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor. Seal space outside sleeve fittings with grout.
 - 3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants".

- O. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - 4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

- P. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

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- Q. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

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1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- N. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.
- 3.3 PIPING CONNECTIONS
- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
 3. Install dielectric unions or flanges for connections of dissimilar metals.
- 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

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- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.
 - 1. Construct concrete pads in accordance with drawing details.
 - 2. Details may be found on structural drawings. If details are not provided comply with the following:
 - a. Housekeeping pads inside the building shall be 4" thick and 6" larger all around than supported equipment. Provide a 1" chamfer on all edges.
 - b. If details are not provided, equipment pads outside the building shall be 8" thick with a 24" deep 12" wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12" larger all around than supported equipment.
 - c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
 - d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
 - e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
 - f. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
 - h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

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- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

3.10 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
 - 1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 - 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 - 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 - 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 - 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 220500

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SECTION 220513 – MOTORS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Equip all motors with overload protection.
 - 1. Locate overload protection near the motor.
 - 2. Overload protection:
 - a. Locate between the circuit breaker/fuse provided under Division 26 and the motor windings.
 - b. Comply with one of the following:
 - 1) Locate in motor by motor manufacturer. (Design Standard)
 - 2) Locate separate overload device near motor.
 - 3) Locate in, or with, disconnect switch by equipment manufacturer. Provision of such switch shall not modify, change, or eliminate Division 26 requirements. Provide indicated disconnecting means.
- B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
- C. Compatible with controller.
- D. Matched to torque and horsepower requirements of the load.
- E. Matched to ratings and characteristics of supply circuit and required control sequence.
- F. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- G. Belt tension must be wrench and socket adjustable.
- H. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

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- A. Motor requirements apply except as follows:
- B. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
- C. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

- A. Frequency Rating: 60 Hz.
- B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- C. Duty: Continuous at 105 deg F and 3300 feet above sea level.
- D. Capacity and Torque sufficient to:
 - 1. Start, accelerate, and operate connected load.
 - 2. Maintain designated speeds.
 - 3. Operate at installed altitude and environment.
 - 4. Operate with indicated operating sequence.
 - 5. Operate without exceeding nameplate ratings.
 - 6. Operate without utilizing service factor.
- E. Enclosure: Open drip-proof unless otherwise indicated.
- F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0

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150	95.4	95.8	94.1	95.8	95.8	95.0
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- C. Efficiency: Premium
- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- M. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - N. Measure winding resistance.
 - O. Read no-load current and speed at rated voltage and frequency.
 - P. Measure locked rotor current at rated frequency.
 - Q. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Perform the following:
 - 1. Run each motor with its controller at load.
 - 2. Demonstrate correct rotation, alignment, and speed.
 - 3. Test interlocks and control features for proper operation.
 - 4. Verify that current in each phase is within nameplate rating.
 - 5. Verify RPM is in accordance with nameplate.
 - 6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

- A. Align motors, bases, and shafts.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 220513

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SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For expansion joints to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 - 1. Available Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.

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2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing 2-1/2" to 4": Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Available Manufacturers:
 - a. Adscos Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Unisource Manufacturing, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.

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- b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
- a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with a minimum of 5 (five) pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four Insert number pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

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- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Available Manufacturers:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Wade
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

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2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. GPT, EnPro Industries
 - d. Metraflex Co.
 - e. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- 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 ¼" clear space between sleeve and pipe or pipe insulation.

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3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.

- E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
 - a. Piping Smaller Than 6": Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for one inch (1") annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping 6" and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

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END OF SECTION 220517

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SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.3 ABBREVIATIONS:

- A. AFF Above finished floor
- B. F Fahrenheit
- C. SS Stainless Steel

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Available Manufacturers:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Terice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in degrees F.
 - 7. Window: Glass
 - 8. Stem: Aluminum length = 1/2 pipe diameter, 1/2 duct width or 12" whichever is less.

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- a. Air-Duct Installation: Provide ventilated shroud.
 - b. Thermowell Installation: Provide Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

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

2.3 PRESSURE GAGES

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

1. Available Manufacturers:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Solid-front, lead-free, pressure relief type; stainless steel; 4-1/2-inch nominal diameter.

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4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Phosphor bronze.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: + or – 1.0 percent of full scale.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings to match sizes.
- C. Install thermowells with extensions on insulated piping.
- D. Install direct-mounted thermometers in thermowells and adjust positions.
- E. Install pressure gages in piping tees located between 36" and 60" above finished floor unless otherwise indicated.
- F. Install valve and snubber for each pressure gage.
- G. Install test plugs in piping tees at locations indicated.
- H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- I. Install flowmeter elements in accessible positions in piping systems.
- J. Install permanent indicators on walls or brackets at 50" above finished floor unless otherwise indicated..
- K. Install connection fittings in accessible locations for attachment to portable indicators.
- L. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- M. Install pressure gages in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Suction and discharge of each pump.
- N. Install a test plug at each thermometer and pressure gauge.

3.2 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 F with 2-degree scale divisions.
- B. Scale Range for Domestic Hot-Water and Hot-Water Recirculation Piping 30 to 240 F with 2-degree scale divisions.

3.3 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 psi to 100 psi.
 - 1. Provide pressure scale range so that normal operating high and low pressures are within 25%-75% of the full scale range.

END OF SECTION 220519

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SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 3. MPTFE: Modified polytetrafluoroethylene plastic.
 4. NBR: Acrylonitrile-butadiene rubber.
 5. PTFE: Polytetrafluoroethylene plastic.
 6. RPTFE: Reinforced polytetrafluoroethylene plastic.
 7. SWP: Steam working pressure.
 8. TFE: Tetrafluoroethylene plastic.
 9. WOG: Water Oil Gas.

1.3 SUBMITTALS

- A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
1. Exceptions: Domestic hot- and cold-water valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance:
1. NSF 61 for valve materials for potable-water service.
 2. NSF 372 for Lead content requirements in drinking water system components.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.

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3. Set ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)
- C. Bronze Valves: 2" and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.
- F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. As indicated in other Part 2 articles.
 2. Where indicated, provide a chain actuator.
 3. Chain Actuator: For attachment to valves of size and mounting height indicated.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- H. Extended Valve Stems: Provide on insulated valves.
- I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.
- J. Valve Grooved Ends: AWWA C606.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

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2.2 COPPER-ALLOY BALL VALVES

- A. Two-Piece, Copper-Alloy Ball Valves (Full Port) (1/4" to 2-1/2"):
1. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem (Un-insulated piping)
 2. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem. Provide 2 1/4" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16
 7. Packing: MPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 1/4" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or RPTFE
 10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
 11. Seats: MPTFE or Reinforced TFE (RPTFE)
 12. Body: Bronze ASTM B-584 for solder or threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
 14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
 15. Conform To: MSS SP-110

2.3 FERROUS-ALLOY BUTTERFLY VALVES

- A. General: Butterfly valves shall provide bi-directional bubble tight dead end service without a downstream flange.
- B. Wafer-lug type butterfly valves:
1. Conbraco Industries-Apollo 141(wafer)/143(lug)
 2. Other Manufacturers:
 - a. Stockham
 - b. Demco
 - c. Nibco
 3. Shaft: ASTM A-582 Type 416 Stainless steel single piece through shaft.
 4. Collar Bushing: ASTM B-124 Brass or PTFE.
 5. Stem Seal: EPDM OR Buna-N Rubber
 6. Body Seal: EPDM Rubber
 7. Upper Bushing: CDA 122 Copper or PTFE
 8. Liner: EPDM Rubber
 9. Disc: ASTM B-148 alloy 954/955 aluminum bronze.
 10. Lower Bushing: CDA 122 copper or PTFE.
 11. Body Wafer: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
 12. Body Lug: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
 13. Ratings:
 - a. 2" through 12" 200 psig CWP.
 - b. 14" through 24" 150 psig CWP.

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14. Conform To: MSS SP-67, MSS SP-25, API-609
 15. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.
- C. Grooved-End 300 psig butterfly valves:
1. Conbraco Industries-Apollo SJ-900N/SJ-900N-L
 2. Other Manufacturers:
 - a. Victaulic
 - b. Nibco
 3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
 4. Upper Bearing: Split metal.
 5. O-Ring: EPDM
 6. Body: ASTM A-395 ductile iron with polyimide coating.
 7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
 8. Lower Bearing: Split metal.
 9. Dust Plug: PVC
 10. Rating: 300 psig CWP.
 11. Conform To: MSS SP-67
 12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.
- D. Flanged 200 psig butterfly valves:
1. Conbraco Industries-Apollo SJ-200
 2. Other Manufacturers:
 - a. Nibco
 3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
 4. Upper Bushing: TFE over porous bronze, steel backed.
 5. O-Ring: EPDM
 6. Body: ASTM A-126 Class B cast iron with polyimide coating.
 7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
 8. Lower Bushing: TFE over porous bronze, steel backed.
 9. Lower Stem: ASTM A-582 Type 416 Stainless steel.
 10. Dust Plug: PVC
 11. Rating: 200 psig CWP.
 12. Conform To: MSS SP-67 and MSS SP-25
 13. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.
- E. Flanged 200 psig butterfly valves for Gas Service:
1. NIBCO Model FC-2765-0
 2. Upper Stem: ASTM A-582 Type 416 Stainless steel.
 3. Upper Bushing: TFE over porous bronze, steel backed.
 4. O-Ring: EPDM
 5. Body: ASTM A-126 Class B cast iron with polyimide coating.

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6. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
7. Lower Bushing: TFE over porous bronze, steel backed.
8. Lower Stem: ASTM A-582 Type 416 Stainless steel.
9. Dust Plug: PVC
10. Rating: 200 psig CWP.
11. Conform To: MSS SP-67 and MSS SP-25
12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

2.4 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:

1. Conbraco Industries-Apollo 161S/T
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:
 - a. Sizes 1/4" thru 3/4": Type 304 stainless steel.
 - b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
 - a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
 - b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:

1. Conbraco Industries-Apollo 61-100 series
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
3. Body: ASTM B-584 alloy C84400 bronze.
4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
5. Ball Check: RPTFE or
6. Disc Holder 316 Stainless steel
 - a. Disc:
 - 1) Water, Oil, Gas: Buna-N
 - 2) Steam: TFE

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- b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
- c. Body End: ASTM B-584 alloy C84400 bronze.
- d. Rating: 125 psig SWP and 250 psig CWP.
- 7. Guide: ASTM B16 Brass
- 8. Spring: Type 316 stainless steel.
- 9. Rating: 125 psig SWP and 400 psig WOG.

2.5 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:

- 1. Conbraco Industries-Apollo 910F
- 2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
- 3. Body Bolt: ASTM A-307 steel.
- 4. Bonnet: ASTM A-126 class B cast iron.
- 5. Body Gasket: Synthetic Fibers.
- 6. Body Nut: ASTM A-307 steel
- 7. Side Plug: ASTM B-16 alloy C36000 Brass.
- 8. Hanger Pin: ASTM B-16 alloy C36000 Brass.
- 9. Hanger: ASTM B-584 alloy C84400 cast bronze.
- 10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
- 11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
- 12. Disc Nut: ASTM B-16 alloy C36000.
- 13. Body: ASTM A-126 class B cast iron.
- 14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
- 15. Disc Plate: ASTM A-126 class B cast iron.
- 16. Disc Cage: ASTM A-126 class B cast iron.
- 17. Rating: 125 psig SWP and 200 psig CWP.
- 18. Conform To: MSS SP-71 Type 1.

B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Apollo SJ-900N with EPDM disc seal.

C. Spring Actuated Silent Check Valves:

- 1. NIBCO Model F-910
- 2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
- 3. Body: ASTM A48 class 35 cast iron.
- 4. Seat: ASTM B-584 alloy C83600 (B) bronze.
- 5. Disc: ASTM B-584 alloy C83600 bronze.
- 6. Spring: Type 302 ASTM A313 stainless steel.
- 7. Bushing:
 - a. 6" and Smaller: ASTM B-16 brass
 - b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
- 8. Set Screws: Type 304 ASTM A-276 stainless steel.

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9. Rating: 200 psig CWP.
10. Conform To: MIL-V-18436F

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

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3.4 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.

- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

- C. Compressed-Air Piping: Use the following types of valves:
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Equipment-Isolation Valves: Safety-Vent, Copper-Alloy Ball Valves (For Compressed Air).
 - 3. Valves, NPS 2-1/2" and 3": Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - 4. Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 - 5. Check Valves, NPS 2-1/2" and Larger: Spring Actuated Silent Check Valves.

- D. Domestic Water Piping: Use the following types of valves:
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 - 5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
 - 6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 - 7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
 - 8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
 - 9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

- E. Gas Piping: Use the following types of valves:
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 - 5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
 - 6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.

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7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. 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 medium.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

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1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, 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.

- B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	4"	3"	2 1/2"	2"	1 1/2"	1 1/4"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8
	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
0	0	0	0	0	16	0	16	

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Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:

- a. Anvil International; a subsidiary of Mueller Water Products Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. Haydon Corporation; H-Strut Division.
- e. NIBCO INC.
- f. PHD Manufacturing, Inc.
- g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4.

4. Channels: Continuous slotted steel channel with in-turned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

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- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
 - 1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

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2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal 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.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

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- K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. 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: Provide 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. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
 - 5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

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1. Provide 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 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes 1/2" to 30".

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2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

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J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

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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. Spring Hangers and Supports: Unless otherwise indicated provide the following:
1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve Schedules: For each piping system to include in maintenance manuals.
- D. 1/16" = 1'-0" scale drawing showing all valve locations to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, Aluminum, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

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3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

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- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, in colors according to ASME A13.1, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch-thick brass or

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2. Material: 0.0375-inch- thick stainless steel or
3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.

B. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 VALVE PLAN

A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.

1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

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PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where not easily visible. Locate nameplates where easily visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units.
 - 2. Pumps, compressors, and other motor-driven equipment.
 - 3. Heat exchangers and similar equipment.
 - 4. Water heaters and storage tanks.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Meters, gages, and thermometers.
 - c. Fuel-burning units.
 - d. Pumps, compressors, and other motor-driven equipment.
 - e. Heat exchangers and similar equipment.
 - f. Water heaters and storage tanks.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where easily visible.

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1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - e. Blue: For equipment not listed in a through d
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.
- F. Install access panel markers with screws on equipment access panels.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in other sections.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 25 feet.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:

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1. Domestic Cold Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
2. Domestic Hot Water and Hot Water Return Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
3. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1 ½", round.
 - b. Domestic Hot Water: 1 ½", round.
 - c. Domestic Hot Water Recirculation: 1 ½", round.
 2. Valve-Tag Color:
 - a. Domestic Cold Water: Blue.
 - b. Domestic Hot Water: Red.
 - c. Domestic Hot Water Recirculation: Red.
 3. Letter Color:
 - a. Domestic Cold Water: Black.
 - b. Domestic Hot Water: White.
 - c. Domestic Hot Water Recirculation: White.

3.5 VALVE SCHEDULE INSTALLATION

- A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.6 VALVE PLAN INSTALLATION

- A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

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3.7 WARNING-TAG INSTALLATION

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

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Outdoor pipe: Pipe located outside the building insulation envelope.
- B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.
- E. Exposed: Visible from any angle without removal of building element or equipment.
- F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 3. Detail attachment and covering of heat tracing inside insulation.
 - 4. Detail insulation application at pipe expansion joints for each type of insulation.
 - 5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 6. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 7. Detail application of field-applied jackets.
 - 8. Detail application at linkages of control devices.
 - 9. Detail field application for each equipment type.

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1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Johns Manville
 - c. Knauf FiberGlass GmbH.
 - d. Owens-Corning Fiberglas Corp.
 - e. Schuller International, Inc.
 2. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.
 3. Polyolefin Insulation:
 - a. Armstrong World Industries, Inc.
 - b. IMCOA.
 4. Closed-Cell Phenolic-Foam Insulation:

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- a. Kooltherm Insulation Products, Ltd.
- 5. Removable Insulation Covers:
 - a. Advance Thermal Corp.

2.2 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:
 - 1. Thickness: 1-1/2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 5.0
 - c. Minimum installed R value assuming 25% compression: 4.0
 - 2. Thickness: 2"
 - a. Density: 1.0 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
 - 3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
 - 4. Thickness: 3"
 - a. Density: 0.75 pcf

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- b. Minimum uncompressed R value: 10.0
 - c. Minimum installed R value assuming 25% compression: 8.3
- I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 - 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 - 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
 - M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- 2.3 FIELD-APPLIED JACKETS
- A. General: ASTM C 921, Type 1, unless otherwise indicated.
 - B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.
 - C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
 - D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. PVC Duct Jacket Color: White or gray.
 - 3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

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- E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
 - 1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
 - 1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
 - 3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.
- G. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.
- H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.4 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz. /sq. yd.
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.

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- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- 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 APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.

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- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.
- O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- P. Install vapor-retarder mastic on pipes and equipment.

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1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
- A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
 2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.
 3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 4. Impale insulation over anchors and attach speed washers.
 5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 6. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
 9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.

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10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
2. Apply adhesive to all surfaces of fittings and equipment.
3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
4. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply 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 jacket manufacturer's recommended adhesive.

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3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as indicated.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 APPLICATIONS

- A. Insulation materials and thickness are specified at the end of this Section.
- B. Insulate all pipe and equipment:
 1. Insulate pipe in accordance with the application schedule(s) below.
 2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic Condensate Drain piping.
 - h. Factory-insulated equipment.
 - i. Flexible connectors.

3.10 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

- A. Service: Domestic hot water and domestic circulated hot water.
 1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
 2. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Copper Pipe, 1/2" through 1 1/4" in diameter: 1"
 - b. Copper Pipe, 1 1/2" through 3" in diameter: 1 1/2"
 - c. Copper Pipe, larger than 3" in diameter: 2"
 3. Vapor Retarder Required: No.
 4. Finish: Exposed = Painted, concealed = none.
- B. Service: Domestic cold water.
 1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
 2. Insulation Thickness: 1/2"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- C. Service: Rainwater conductors (Including secondary roof drain conductors). Insulate first thirty linear feet of piping including vertical piping from drain body and first horizontal piping run. If a second vertical run occurs before thirty linear feet is reached, terminate insulation at end of first horizontal run.

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1. Insulation Material: Mineral fiber preformed pipe insulation or Mineral-Fiber Blanket with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- D. Service: Roof drain and overflow drain bodies.
1. Insulation Material: Semi-Rigid Mineral-Fiber Board Thermal Insulation
 2. Insulation Thickness: 1½"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- E. Service: Exposed piping:
1. Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- F. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- G. Service: Condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- H. Service: Equipment Non-condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- 3.11 INDOOR APPLICATION SCHEDULE (BELOW GRADE):
1. None required.

END OF SECTION 220700

SECTION 220800 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 250800 – Commissioning of Integrated Automation Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. The purpose of this section is to specify commissioning responsibilities directly related to the Division 22 contractors and vendors. All contractors responsible for Division 22 installation or other activities shall have commissioning responsibilities described herein.
- B. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Plumbing Contractors alone.
- C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Plumbing Systems, which are a part of this project.
- D. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.
- E. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The plumbing trades represented on the Commissioning Team shall include but not be limited to; pipe and fitting, controls, test and balance, plumbing, vendors, manufactures, and water treatment. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

- F. Plumbing Contractor(s) are responsible for plumbing system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 22 specification sections. Plumbing Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- G. Sections 019113 - Commissioning General Requirements and 220800 – Commissioning of Plumbing Systems DO NOT relieve the Plumbing Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 220800 – Commissioning of Plumbing Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

1.3 DEFINITIONS

- A. Plumbing Contractor(s): The term Plumbing Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 22 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 22 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 22 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing disinfection activities or a company performing water quality tests for potable water.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

1.4 ROLES AND RESPONSIBILITIES

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vendor or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 22 of the specifications and project drawings.

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- B. Every Plumbing Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that companies Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 22 Contractors are responsible for the requirements defined in specification 019113 section 1.4 subsections for their particular role:
- D. Plumbing Contractor(s)
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Equipment Manufacturer(s)
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- F. Third Party Testing Agencies
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.

2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

1.5 SYSTEMS INCLUDED IN COMMISSIONING

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 22 Plumbing Systems included within the Commissioning Scope.

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
 1. Quality Control Plans and Tests
 2. Electrical Energization
 3. Equipment and Systems Start-Up
 4. Pre-Functional Checklist Completion
 5. Third Party Testing
 6. Pre-Verification Testing

7. Functional Performance Testing
8. Training and Orientation
9. Close-Out Document Review (O&M's, As-Builts, Warranties)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Work products to be provided by the Plumbing Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Plumbing Contractors, Manufacturers and Third Party Test Agencies Include:
 1. 2.1 - Project Schedule
 2. 2.2 - Submittals
 3. 2.3 - Quality Control Plan
 4. 2.4 - Quality Control Reports
 5. 2.5 - Pre-Functional Checklists
 6. 2.7 - Systems and Equipment Start-Up Plan
 7. 2.9 - Systems and Equipment Start-Up Reports
 8. 2.10 - Pre-Verification Tests
 9. 2.11 - Functional Performance Tests
 10. 2.12 - Systems and Equipment Training Plan
 11. 2.13 - Test and Proprietary Equipment
- B. Work products under the Construction Manger/General Contractor purview are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure products are up to date and accurate.
- C. Work products under the Contractors purview outside of Division 22 are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 22 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 22 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

PART 3 - EXECUTION

3.1 GENERAL

- A. Execution of Commissioning Activities to be performed by the Plumbing Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Plumbing Contractors, Manufacturers and Third Party Test Agencies Include:

1. 3.1 – Commissioning Plan and Kick-Off Meeting
2. 3.2 – Construction Observations
3. 3.5 – Systems and Equipment Start-Up
4. 3.6 – Temporary Utilization
5. 3.7 – Quality Control and Start-Up Reporting
6. 3.8 – Pre-Functional Checklists
 - a. Plumbing PFC's are primarily the responsibility of the Plumbing Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to complete portions of the Plumbing PFC's. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
 - b. Plumbing Contractors are responsible for portions of PFC's which are primarily the responsibility of other Contractors such as Fire Protection or Mechanical. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
7. 3.9 – Pre-Verification Tests
 - a. Plumbing PVT's are primarily the responsibility of the Plumbing Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Plumbing PVT's. For these activities, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
 - b. Plumbing Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Fire Protection or Mechanical. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
8. 3.10 – Functional Performance Tests
 - a. Plumbing FPT's are primarily the responsibility of the Plumbing Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Plumbing FPT's. For these activities, the Plumbing

Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.

- b. Plumbing Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Fire Protection or Mechanical. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.

9. 3.11 – TAB Verification

- a. Test, Adjustment and Balance is generally considered a Mechanical Trade and performed under Division 23. However, all fluid flowing equipment such as pumps must be properly tested for operational characteristics typically performed by a TAB contractor. Additionally, Balancing Valves or Circuit Setters which set flow rates throughout the Plumbing Systems must also be adjusted and balanced by a TAB contractor. The Plumbing Contractor may coordinate with the Mechanical Contractor to include these services within the same TAB Contractor scope or may utilize an independent company. Ultimately, the Plumbing Contractor will be required to demonstrate operational and flow characteristics to the Commissioning Team as part of Quality Control and Functional Testing.

10. 3.12 – Integrated Systems Test

11. 3.13 – Operations and Maintenance Manuals

12. 3.14 – Systems and Equipment Training

13. 3.15 – Exclusions

14. 3.16 – Prerequisites to Substantial Completion

- B. Execution of Commissioning Activities under the Construction Manager/General Contractor purview are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure activities are executed without any impedance or interference by Division 22 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 22 are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 22 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 22 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

3.2 SCHEDULE

- A. The Plumbing Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Plumbing Systems such that all deficiencies are resolved prior to Final Acceptance.

3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES

- A. The Plumbing Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 22. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Plumbing Contractor(s). Plumbing Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Plumbing Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.4 DEFICIENCIES AND FAILURES

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.

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- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. This is referred to as the Percent Failure Time. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. The percent of the failure time out of the total test time is calculated as follows:
1. Total Time = The total time the team is present to witness the entire test activity (including down time.)
 2. Down Time = Time spent by the Commissioning Team while waiting for reparations or waiting on any contractor to arrive or prepare their activities.
 3. Test Time = The time the test should take if execution goes correctly without delays or deficiencies.
 4. Test Time = Total Time – Down Time
 5. Percent Failure Time = Down Time / Test Time
 6. Example 1: Commissioning Team is on site for an 8 hour day but only 4 hours are effectively witnessing test activities due to a few delays: waiting for the test equipment to arrive, system adjustments are made during testing, etc. Test Time = 4. Down Time = 4. Failure Percent Time = $4 / 4 = 100\%$. Ultimately, the Commissioning Team doubled the time that should have been spent witnessing this small test. The Commissioning Agent may request reimbursement for the additional 4 hours spent on site.
 7. Example 2: Commissioning Team is on site for an 8 hour day and 7 hours and thirty five minutes are effectively witnessing test activities due to only minor system adjustments. Test Time = 7.6. Down Time = 0.4. Failure Percent Time = $0.4 / 7.6 = 5\%$. Ultimately, the Commissioning Team spent a whole day on site which would have been needed regardless of the minor adjustments. The Commissioning Agent would not request reimbursement for the additional 25 minutes spent on site. This is considered reasonable.

- F. A test failure of a reading may vary depending upon the criticality of the reading. For example, general hot water temperature leaving a mixing valve may be allowed to be within 10% of the expected value without being considered a failure. However, hot water temperatures serving an eye wash station have a zero tolerance for being outside of the code required range. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- G. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- H. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

3.5 DEFICIENCY RESOLUTION

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.6 ADDITIONAL COMMISSIONING

- A. The Plumbing Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, additional inspections due to false PFC's, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at a rate of \$152/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager/General Contractor's Application for Payment. The Construction Manager/General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

3.7 SEASONAL COMMISSIONING

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

END OF SECTION 220800

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SECTION 221113 – FACILITY NATURAL-GAS PIPING

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
 - 3. Service Meter: 65 psig minimum unless otherwise indicated.
- B. Gas System Pressures: Primary pressure from the utility is more than 2.0 psig, and is reduced to a secondary pressure of 2.0 psig by a pressure reducing valve installed immediately downstream of the meter, and is reduced again by pressure reducing valves located at each piece of equipment.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings bypass fittings and meter bars meter bars.
 - 6. Dielectric fittings.

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- B. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components and Devices: If indicated, provide electrical components and devices that are listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Applicable Codes: Comply with the 2015 South Carolina Fuel Gas Code.
- C. Fuel Gas Piping: Listed and labeled as required by the 2015 South Carolina Fuel Gas Code.
- D. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" where UL listing is indicated.
- E. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Perform site survey: Contract with utility-locating service for area where Project is located, and locate utilities.
- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: 1000 Btu/cu.ft.
 - 2. Nominal Specific Gravity: 0.60
- C. Interruption of Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after

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arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Architect and Owner's written permission.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 5. 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.

2.3 POLYETHYLENE PIPE, FITTINGS, AND JOINING MATERIALS

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- A. Available Manufacturers:
 - 1. ERS Inc.
 - 2. Titeflex Corp.
- B. Polyethylene Pipe: Pipe shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- C. Polyethylene Fittings: Fittings shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- D. Joining Materials: Joining materials shall be as recommended by the pipe and fitting manufacturer for service intended.

2.4 PROTECTIVE COATING

- A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in corrosive atmosphere.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 VALVES

- A. Refer to section "General Duty Valves for Plumbing Piping".

2.7 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72"
- B. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

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2. End Connections: Threaded ends for 2" and smaller; flanged ends for 2 ½" and larger.
 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.8 SPECIALTY VALVES

A. Available Manufacturers:

1. ASCO General Controls.
2. Automatic Switch Co.
3. Eaton Corp.; Controls Div.
4. Honeywell, Inc.
5. Johnson Controls, Inc.

B. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.

2.9 Valves, 2" and Smaller: Ball valves with threaded ends according to ASME B1.20.1 for pipe threads.

2.10 Valves, 2-1/2" and Larger: Butterfly valves for use with flanged ends according to ASME B16.5 for steel flanges.

2.11 PRESSURE REGULATORS

A. Available Manufacturers:

1. Line Pressure Regulators:
 - a. American Meter Co.
 - b. Donkin: Bryan Donkin RMG Canada, Ltd.
 - c. Eclipse Combustion, Inc.
 - d. Equimeter, Inc.
 - e. Fisher Controls International, Inc.
 - f. Maxitrol Co.
 - g. National Meter.
 - h. Richards Industries, Inc.; Jordan Valve Div.
 - i. Schlumberger Industries; Gas Div.

B. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. 2" and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

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2. 2 ½" and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 3. Line Pressure Regulators: ANSI Z21.80 with 5-psig minimum inlet pressure rating.
 4. Appliance Pressure Regulators: ANSI Z21.18 with 2-psig minimum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction. If vents are required provided piping necessary to extend to termination location outside the building as approved by the architect.
- C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Extend to exterior of building and terminate in location approved by the architect.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Available Manufacturers:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 2. Body and Diaphragm Case: Die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber.
 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 9. Maximum Inlet Pressure: 2 psig.

2.12 CONCRETE BASES

- A. Description: Reinforced concrete base formed of 3000-psi- minimum, 28-day compressive strength concrete, and measuring 6 inches thick and 6 inches larger in each dimension than equipment, unless otherwise indicated.

2.13 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - f. Wilkins; Zurn Plumbing Products Group.

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2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.14 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

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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. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- B. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping and connect to fuel gas distribution piping downstream of meter.
 - 1. Service meter will be provided by Local Gas Utility.
- B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Refer to Division 22 Section "Common Work Results for Plumbing" for dielectric fittings.

3.4 CONCRETE BASE INSTALLATION

- A. Locate bases at service meters and service regulators.
- B. Excavate earth and make level beds to support bases. Form and pour concrete bases level with top surface projecting approximately 3 inches above grade.

3.5 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

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2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- E. Copper Tubing 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. Install fittings for changes in direction and branch connections.
- F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

3.6 INDOOR PIPING INSTALLATION

- 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 be accepted by architect.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms.
- E. Install piping indicated to be exposed and piping in equipment rooms at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade 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

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same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install pre-sleeved corrugated, stainless-steel tubing systems for natural-gas. Cover with minimum of 1-1/2 inches of concrete. Jacket may not be in physical contact with metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives.
 - 3. 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.
 - 4. 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.

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- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes 2" and smaller, adjacent to each valve, at final connection to each piece of equipment and where otherwise indicated. Unions are not required at flanged connections.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- Y. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- Z. Install containment casings for gas piping below slabs extending minimum of 2 inches beyond point where pipe emerges from the floor. Tightly seal ends around gas piping using mechanical sleeve seals.

3.7 SERVICE-METER ASSEMBLY INSTALLATION

- A. Provide concrete base for service meter.
- B. Install locking shutoff valves downstream from service regulator. Shutoff valves are not required at second regulator if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator.
- D. Install service pressure regulator 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.

3.8 VALVE INSTALLATION

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- 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.

3.9 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 dry-seal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. 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, then use wrench. Do not over-tighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.10 HANGER AND SUPPORT INSTALLATION

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- A. Comply with requirements for pipe hangers and supports specified in Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 1" and Smaller: Maximum span, 96"; minimum rod size, 3/8".
 - 2. 1 1/4": Maximum span, 108"; minimum rod size, 3/8".
 - 3. 1 1/2" and 2": Maximum span, 108"; minimum rod size, 3/8".
 - 4. 2 1/2" to 3 1/2": Maximum span, 10'-0"; minimum rod size, 1/2".
 - 5. 4" and Larger: Maximum span, 10'-0"; minimum rod size, 5/8".

3.11 CONNECTIONS

- A. Connect to utility's gas meter according to utility's procedures and requirements.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72" of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.12 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Above Ground Exposed Fuel Gas Piping:
 - 1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. 2 1/2" to 4": Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
 - 3. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- C. Above Ground Concealed Fuel Gas Piping:
 - 1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. 2 1/2" to 4": Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
 - 3. Larger Than NPS 4: Steel pipe, steel welding fittings, and welded joints.
- D. Exterior Underground Fuel Gas Piping:
 - 1. All Sizes: Polyethylene pipe, fittings and joining materials.

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E. Under Slab Fuel Gas Piping: (NOTICE: Method of fuel gas piping installation below floor slab must be approved by the local code authority.)

1. Pre-Sleeved Corrugated, Stainless-Steel Tubing Systems.
2. Steel pipe, steel welding fittings, and welded joints with welded steel vented conduit.

3.13 LABELING AND IDENTIFYING

- A. Comply with requirements in Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12" minimum below finished grade.
 1. Exception: 6 minimum below sub-grade under pavements and slabs.

3.14 PAINTING

- A. Use materials and procedures in Division 9 Section "Painting," "Exterior Paint Schedule" Article, "Ferrous Metal" Paragraph, "Full-Gloss, Alkyd-Enamel Finish" Subparagraph.
- B. Paint exterior service meters, pressure regulators, specialty valves, and piping.
 1. Color: Gray.

3.15 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.16 ADJUSTING

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- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 221113

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SECTION 221116 –DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Service Piping: 160 psig.
 - 2. Domestic Water Distribution Piping: 125 psig.
- B. Seismic Performance: Refer to structural drawings for seismic category. Domestic water piping, support, and installation shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7, state, and local codes.

1.3 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Water Samples: Specified in “Cleaning” Article.
- D. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.
- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. NSF/ANSI Compliance:

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1. NSF/ANSI 61, "Drinking Water System Components – Health Effects"
2. NSF/ANSI 372, "Drinking Water System Components – Lead Content"

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's, Construction Manager's, and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. 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.
 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Conex Banninger
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 6. Copper Push-on-Joint Fittings:

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- 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) NVent LLC.
- b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
7. Copper-Tube Extruded-Tee Connections:
 - 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) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
8. Grooved-Joint Copper-Tube Appurtenances:
 - 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 International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Conex Banninger
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

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- c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to other sections for excavating, trenching, and backfilling.

3.2 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 may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Options:
 - 1. Mechanically formed tee-branch outlets (T-Drill) and brazed joints may be used on aboveground copper tubing.
 - 2. Press Fittings: Mechanically crimped fittings with neoprene gasket.
- E. Underground Domestic Water Service Piping: Match civil materials to first flange.
- F. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. 2" and Smaller:
 - a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
 - 2. 2-1/2" and above":
 - a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
 - b. Hard copper tube, Type L with grooved ends; copper grooved-end fittings; copper-tubing, keyed couplings; and grooved joints.

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- G. Underground Domestic Water Piping: Use the following piping materials for each size range:
1. 2" and Smaller:
 - a. Soft copper tube, Type K copper pressure fittings; and soldered joints with no joints permitted below concrete slabs.
 2. 2-1/2" and above:
 - a. Soft copper tube, Type K copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water-Piping, Balancing Duty: Use automatic flow control valves.
 4. Drain Duty: Hose-end drain valves.
- B. Grooved-end valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION

- A. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- B. Install underground ductile-iron piping according to AWWA C600, and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.
- C. Install underground copper according to CDA's "Copper Tube Handbook."
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
- E. Install water-pressure regulators downstream from shutoff valves.
- F. Install aboveground domestic water piping level and plumb.
- G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- H. Perform the following steps 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.

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4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
 - J. Check plumbing specialties and verify proper settings, adjustments, and operation.
 1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
 - K. Energize pumps and verify proper operation.

3.5 JOINT CONSTRUCTION

- A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- B. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. 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.
- D. Mechanically crimped fittings shall be installed in accordance with manufacturer's installation instructions and by factory accredited installer.

3.6 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.7 HANGER AND SUPPORT INSTALLATION

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- A. Refer to Section 220529 "Hangers and Supports for Plumbing Piping" for pipe hanger and support devices.
- B. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Where hangers for piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- I. Where bends in the pipe occur, place hangers 1/3 of the maximum allowed spacing distance of the bend (i.e. is the maximum span is 12 feet, the hanger shall be 4 feet from the bend. Pipe shall be supported from both sides of the bend.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

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3.9 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.

3.11 CLEANING

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.

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2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in AWWA C651, AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities to authorities having jurisdiction.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

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

1.3 SUBMITTALS

- A. Product Data: For each type of product proposed.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components – Health Effects"
 - 2. Comply with NSF 372, "Drinking Water System Components – Lead Content"
 - 3. Comply with NSF 14, "Plastic Piping System Components and Related Materials"
- C. Water Management Installation:
 - 1. Installer Qualifications: An installer who is authorized by the equipment manufacturer for both installation and maintenance of submitted equipment.
 - 2. Provide documentation demonstrating previous experience and successfully completing projects of similar size and scope.
 - 3. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Similar installations from other vendors and/or Installers shall be accepted. The Installer's employees must meet these qualifications.
 - 4. The Installer shall demonstrate to the satisfaction of the Architect/Engineer that he has:
 - a. Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. Adequate staff and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.

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- d. Technical capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
5. A contractor intending to bid on this work, not meeting the requirements of this section, may employ the services of an "Installer" meeting the requirements of this section. A "subcontractor" so employed must be acceptable to the Architect. The "Installer" shall be identified by submittal for acceptance by the Architect.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type (Anti-siphon) Vacuum Breakers:

1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Sizes: ¾" thru 3" as required to match connected piping.
4. Body: Brass or Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze or chrome plated.

B. Pressure Vacuum Breakers:

1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

C. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers:
 - a. Apollo Valves - Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.

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4. Sizes: ¾" thru 1" as required to match connected piping.
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 DISHWASHER AIR-GAP FITTINGS

- A. Description: ASSE 1021, fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
- B. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 1. Inlet Hose: 5/8-inch- ID and 48 inches long.
 2. Outlet Hose: 7/8-inch- ID and 48 inches long.

2.3 WATER FILTERS

- A. Refer to the drawings for information on water filters.
- B. Available Manufacturers:
- C. Manufacturers:
 1. Campbell Manufacturing, Inc.
 2. Consler Corporation.
 3. CUNO, Incorporated.
 4. Eagle Spring Filtration, Inc.
 5. Eden Equipment Company.
 6. Filpro Corporation.
 7. Filterspun.
 8. Filtrine Manufacturing Company; Drinking Water Division.
 9. Harmsco Industrial Filters.
 10. Manitowoc Ice, Inc.
 11. Met-Pro Corporation; Keystone Filter Division.
 12. Osmonics.
 13. Pall Corporation.
 14. Plymouth Products, Inc.
 15. PURA, Inc.
 16. U.S. Filter; Filterite Div.
 17. Waterlink, Inc.
 18. Watts Industries, Inc.; Water Products Div.
 19. Whatman, Inc.; Balston Div.
- D. General: Cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge end caps.
- E. Wall-Mounting Type: Housing head section with threaded inlet and outlet, mounting bracket, and removable lower section for 10-inch- long filter cartridge.

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1. Housing Material: Plastic, 125-psig minimum operating pressure.
2. Cartridge: Wound- or molded-fiber or pleated-polypropylene filter media, 10 inches, 10-micron-particulate removable rating.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Zone (RPZ) Backflow Preventers:

1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
5. Sizes: 3/4" thru 10"
6. Body: Brass or bronze for 2" and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for 2 1/2" and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 1/2" and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers:
 - a. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - b. Mueller Co.; Water Products Div.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Sizes: 3/4" thru 1" as required to match connected piping.
5. Body: Bronze with union inlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Available Manufacturers:

1. CLA-VAL Automatic Control Valves.
2. Flomatic Corporation.

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3. OCV Control Valves.
4. Watts Industries, Inc.; Ames Fluid Control Systems.
5. Watts Industries, Inc.; Watts ACV.
6. Zurn Plumbing Products Group; Wilkins Div.

- B. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
- C. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
- D. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
1. Sizes: 1¼" thru 10" as required to match connected piping.
 2. Pattern: Angle or Globe-valve design.
 3. Trim: Stainless steel.

2.6 CALIBRATED BALANCING VALVES

- A. Available Manufacturers:
1. NIBCO
 2. Armstrong Pumps, Inc.
 3. Flow Design, Inc.
 4. Griswold Controls.
 5. ITT Bell & Gossett; ITT Fluid Technology Corp.
 6. Nexus Valve.
 7. NuTech Hydronic Specialty Products
 8. Taco, Inc.
- B. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- C. NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

2.7 MOTORIZED CONTROL VALVES

- A. Electrically Operated Valves: Comply with UL 429.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson. Model 8210
 - b. Magnatrol Valve Corporation.
 - c. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.

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- d. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
2. Pilot operated.
3. Body: Brass or Aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 24V-120V, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
 - a. Verify and coordinate final power requirements with power availability.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.
10. Provide wye pattern strainer on inlet of all solenoid and motorized valves.

2.8 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic Water Mixing Valves:

1. Refer to drawing schedule for manufacturer and operating requirements.
2. Available Manufacturers:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: union inlets and outlet.
7. Accessories:
 - a. Check stops on hot- and cold-water supplies.
 - b. Handle.
 - c. Dial thermometer on inlets and outlet.
 - d. Pressure gauges on inlets and outlet.
8. Pressure Rating: 125 psig, unless otherwise indicated.

B. Individual-Fixture, Water Tempering Valves:

1. Refer to drawing schedule for manufacturer and operating requirements.
2. Available Manufacturers:
 - a. Apollo Valves - Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1070, thermostatically controlled water tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.

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5. Body: Bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded. Provide unions and valves.
8. Finish: Chrome-plated bronze.

2.9 STRAINERS

A. Pattern: "Y"

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.10 WATER HAMMER ARRESTERS

A. Available Manufacturers:

1. AMTROL, Inc.
2. Josam Company.
3. MIFAB, Inc.
4. PPP Inc.
5. Sioux Chief Manufacturing Company, Inc.
6. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
7. Tyler Pipe; Wade Div.
8. Watts Drainage Products Inc.
9. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Standard: ASSE 1010 or PDI-WH 201.

C. Type: Metal bellows or copper tube with piston.

D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers:

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- a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.12 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Available Manufacturers:
2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP Inc.
3. Standard: ASSE 1044
4. Piping: ASTM B 88, Type L; copper, water tubing.
5. Cabinet: Unless otherwise indicated, recessed or surface-mounting steel box with stainless-steel cover.
6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
7. Vacuum Breaker: ASSE 1001.
8. Number of Outlets: Refer to drawings.
9. Size of Outlets: 1/2"

2.13 HOSE BIBBS

- A. Refer to plumbing fixture rough-in schedule on drawings.

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2.14 WALL HYDRANTS

- A. Refer to plumbing fixture rough-in schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers where indicated: If not indicated on 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 not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install balancing valves with-in 12" of ceiling at access door or tile where they can be reached with-out obstruction.
- D. Install thermostatic mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and pressure gauges.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as indicated.
- E. Install strainers where indicated.
- F. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section "Rough Carpentry."
- G. Install water hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting.

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- J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- K. Install trap guards in accordance with manufacturer's instructions.
- L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- M. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Section "Valves" for general-duty ball valves.
- P. Install air vents at water piping high points. Include ball valve in inlet.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- S. Specific trap primer assembly and primer pipe routing not always indicated on plans to provide contactor field flexibility in selecting option best suitable for field conditions, where alternative options may be acceptable. Contactor shall coordinate and provide any necessary items to facilitate proper installation and operation of the preferred and approved primer system; to include, but not limited to, electrical conduit and circuitry to the panelboard for electronic systems.

3.2 LABELING AND IDENTIFYING

- A. Indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Plumbing Identification"

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principal backflow preventer, double-check backflow-preventer and double-check, detector-assembly according to authorities having jurisdiction and the device manufacturer's recommendations.

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- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

- A. Set field-adjustable pressure set points.
- B. Set field-adjustable flow set points.
- C. Set field-adjustable temperature set points.

END OF SECTION 221119

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SECTION 221125 - CIRCULATING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

- A. BAS Building Automation System

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.5 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect against damage.
- C. Comply with pump manufacturer's written instructions for handling.

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PART 2 - PRODUCTS

2.1 CIRCULATING PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Grundfos Pumps Corp.
 2. TACO Incorporated.
 3. Bell & Gossett Domestic Pump; ITT Corporation.
 4. Armstrong Pumps Inc.
- B. Description: Factory-assembled and -tested, in-line, wet rotor or system lubricated, close-coupled, 100% lead free, overhung-impeller, designed for circulating domestic hot water.
- C. Pump Construction:
1. Pump and Motor Assembly: Hermetically sealed, cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 2. Motor: Non-overloading at all points on the pump curve
 3. Casing: Bronze, with companion-flange connections.
 4. Impeller: Plastic.
 5. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing 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 Division 26 Sections.

2.3 CONTROLS

- A. BAS: Electric, adjustable for control of water-supply pump.
1. Type: Start/Stop
 2. Operation of Pump: Refer to Section "Sequence of Operation".

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.
- B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, centrifugal pumps with shaft horizontal unless otherwise indicated.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps.
- D. Install suction and discharge piping.
- E. Install indicated valves & devices.
- F. Comply with Division 26 Sections for electrical connections.
- G. Connect controls.
- H. Interlock pump with water heater to deactivate water heater when pump is deactivated..

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Check operation of controls for automatic starting and stopping operation of pumps.

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5. Perform the following startup checks for each pump before starting:
 - a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - b. Verify that pump is rotating in the correct direction.
6. Prime pump.
7. Close discharge valve.
8. Start motor.
9. Open discharge valve slowly.
10. Adjust temperature settings on thermostatic mixing valves if included in design.
11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
12. Check and record pressure on inlet and outlet of pump.

END OF SECTION 221125

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. The following are industry abbreviations for plastic and rubber piping materials:
1. EPDM: Ethylene-propylene-diene terpolymer.
 2. NBR: Acrylonitrile-butadiene rubber.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
 5. TPE: Thermoplastic elastomer.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of testing agency.
- B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.
1. Third party certifier shall be IAPMO, ICC, NSF, UL, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 CAST-IRON SOIL PIPING

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Hub-and-Spigot Gaskets: ASTM C 564, rubber.
- C. Hub-less Couplings:
 - 1. General: CISPI 310 and ASTM C 1277 assembly of stainless-steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - 1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
 - a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
 - b) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
 - b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- D. Manufacturers:
 - 1. AB&I Foundry
 - 2. Charlotte Pipe & Foundry Co.
 - 3. NewAge Casting
 - 4. Tyler Pipe & Coupling

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).]

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2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground, Soil, Waste, and Vent Piping located inside plenum: Hub-less cast-iron soil piping with heavy duty couplings.
- C. Underground, Soil, Waste, and Vent Piping:
 - 1. Kitchen Waste: Extra Heavy Hub and Spigot cast-iron soil piping.
 - 2. Other than kitchen waste: PVC pipe and fittings.
- E. Food Service Equipment, Soil and Waste Piping
 - 1. Food Service Equipment Waste: Copper DWV pipe and fittings.

3.2 PIPING INSTALLATION

- A. Refer to Section "Facility Sanitary Sewers" for Project-site sanitary sewer piping.
- B. Refer to Section "Common Work Results for Plumbing" for basic installation.
- C. Install seismic restraints on piping when indicated. Seismic-restraint devices are not required in zones A & B. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install seismic restraints on piping when indicated. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- G. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

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- H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Section "Sleeves and Sleeve Seals for Plumbing Piping" for sleeves and mechanical sleeve seals.
- I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back-to-back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the minimum slopes required by authorities having jurisdiction.
- M. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- N. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install all drainage pattern fittings and piping in accordance with all applicable federal, state, and local codes.
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete and masonry walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping"

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3.3 JOINT CONSTRUCTION

- A. Refer to Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-less cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hub-less-coupling joints.
- D. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.
- E. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
- B. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze where indicated.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Section "Hangers and Supports for Plumbing Piping and Equipment"
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1 1/2" and 2": 60" with 3/8" rod.
 - 2. 3": 60" with 1/2" rod.
 - 3. 4" and NPS 5: 60" with 5/8" rod.
 - 4. 6": 60" with 3/4" rod.
 - 5. 8" to 12": 60" with 7/8" rod.
 - 6. 15": 60" with 1" rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

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- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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 drainage and vent piping.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Where required or indicated prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.7 CLEANING

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

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. RPZ Reduced Pressure Zone
- B. FOG Fats, oils, and greases.

1.3 DEFINITIONS

- A. Withstand: Units shall remain in place without separation of any parts when subjected to seismic forces indicated. "Essential facility" units shall be fully operational after the seismic event.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.
- B. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings: Identify center of gravity and locate & describe mounting and anchorage provisions.
 - 3. Detailed Description: Provide detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical components, devices, and accessories shall be Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.
- B. Coordinate accessories, extensions, collars, flashing clamps, etc... for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. General:
 - 1. Available Manufacturers:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected drainage piping
 - 4. Closure Material: Match pipe, brass, PVC, or ABS
- B. Floor Cleanouts:
 - 1. Housing: threaded, adjustable.
 - 2. Type: Threaded, adjustable housing.
 - 3. Body: Cast iron.
 - 4. Outlet Connection: Inside calk, Spigot, or Threaded.
 - 5. Adjustable Housing Material: Cast iron with threads.
 - 6. Frame and Cover Material and Finish: Satin finish nikaloy.
 - 7. Frame and Cover Shape: Round or Square (Contractors Option).
 - 8. Top Loading Classification: Extra Heavy Duty.
 - 9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
 - 10. Carpet Ring: Yes for carpeted floors.
 - 11. Tile Recess: Yes for tiled floors.

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12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
3. Pattern: As indicated.
4. Clamping Flange: Required.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating (For Use Where Plastic Laboratory Stacks are Indicated): Corrosion resistant on interior of fittings.

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2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP
 - b. Josam
 - c. Smith
 - d. Zurn
2. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
3. Size: Same as floor drain inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.5 GREASE INTERCEPTORS

A. General: Grease and solids interceptor having capacity indicated (Refer to Plumbing Schedules).

B. Design: Interceptor shall be designed to remove from wastewater free oil, grease, and other floatable materials, and sediment, sand and other settleable materials.

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

D. Available Manufacturers:

1. Adamson Tank
2. Clawson Tank
3. FOG Enforcer
4. GreenTurtleTech
5. Highland Tank
6. Schier Products

E. Equivalent interceptors constructed of fiberglass or steel by other manufacturers will be considered. Interceptor manufacturer must document compliance with all requirements of this specification. Capacity information must be from the manufacturer's catalog. Site constructed concrete interceptors are not acceptable.

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- F. Interceptor shall meet the requirements of the International Association of Plumbing and Mechanical Officials (IAPMO) Material and Property Standard for Grease Interceptors and Clarifiers ANSI/IAPMO Z1001-2007.
- G. Steel Interceptors shall be in accordance with Underwriters Laboratories Inc. Subject UL-1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks.
- H. Interceptor shall consist of inlet and outlet connections with internal influent nozzle, non-clogging flow diffusion and energy dissipater baffle. If distributed pipe configuration is proposed pipe diameter shall be twice the diameter of the inlet pipe and shall direct flow across the entire cross-sectional area. Straight pipe is not acceptable.
- I. Interceptor shall be designed to prevent large amounts of pipe-clogging fats, oil, and grease (FOG) and solid waste materials from entering the sanitary sewer system. Interceptor shall have compartments to minimize turbulence and promote separation. Interceptor shall retain wastewater long enough to allow liquefied grease to cool down, separate, and congeal.
- J. Interceptor shall be suitable for underground installation and shall be installed per the manufacturer's recommendations.
- K. Provide interceptor with cleanouts, sample, and ventilation ports together with extension collars, frames, and covers to allow access for removal of oil, grease and solids.
- L. Accessories:
 - 1. Basin manways with extensions to grade and heavy duty covers.
 - 2. Full line-size connections.
 - 3. Vertical tee fitting on discharge outlet with pipe to surface with cast iron frame and cover for effluent sampling.
 - 4. Traffic rated components accessories and relieving slabs where installation subject to vehicular traffic.
 - 5. Grease level monitoring and alarm system
- M. Warranty: 30 years against leakage, corrosion, and structural failure.

2.6 MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing 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: Electrical devices and connections are specified in Division 26 Sections.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts.
- C. Install cleanout deck plates with top flush with finished floor.
- D. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains as indicated. If indication is not clear, position for easy access and maintenance.
 - 2. Set floor drains at elevations indicated.
 - 3. Install floor-drain flashing flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain.
- F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.
- I. Install air-gap fittings on RPZ backflow preventers and where indicated.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.
- L. Install solids interceptors according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.

3.2 CONNECTIONS

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

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- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Grease interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, and refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect grease interceptors and their installation, including piping and electrical connections, and to assist in testing.
- B. Checks and Inspections:
 - 1. Leak Check: After installation, charge system and check for leaks. Repair leaks and recheck until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

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SECTION 221413 – FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. LEED: Leadership in Energy and Environmental Design
- B. PE: Polyethylene plastic.
- C. USGBC: United States Green Building Council

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with a minimum working-pressure rating of 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of the testing agency.
- B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.
 - 1. Third party certifier shall be IAPMO, ICC, NSF, UL, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

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2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Hub-and-Spigot Gaskets: ASTM C 564, rubber.
- C. Hub-less Couplings:
 - 1. General: CISPI 310 and ASTM C 1277 assembly of stainless steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - 1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
 - a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
 - b) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
 - b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- D. Manufacturers:
 - 1. AB&I Foundry
 - 2. Charlotte Pipe & Foundry Co.
 - 3. NewAge Casting
 - 4. Tyler Pipe & Coupling

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Solvent Cement and Adhesive Primer:
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural

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PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

- B. Above ground Storm Drainage Piping: Unless indicated otherwise use any of the following piping materials for each size range:

1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
4. 5" and 6": Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
5. 8" and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
6. 8" and Larger: Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.

- C. Underground Storm Drainage Piping: Use any of the following piping materials for each size range:

1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
4. 5" and 6": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
5. NPS 8 and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
6. NPS 8 and Larger: Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.

3.3 PIPING INSTALLATION

- A. Refer to Section " Storm Utility Drainage Piping" for Project site storm sewer and drainage piping.

- B. Refer to Section "Common Work Results for Plumbing" for basic piping installation.

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- C. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
 - D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Section "Storm Drainage Piping Specialties".
 - E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
 - F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
 - J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
 - K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
 - M. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
 - N. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping."
- 3.4 JOINT CONSTRUCTION
- A. Refer to Section "Common Work Results for Plumbing" for basic piping joint construction.
 - B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

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- C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backlog.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Install backwater valves in accessible locations.
 - 3. Refer to Section "Storm Drainage Piping Specialties" for backwater valves.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
- B. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1 1/2" and 2": 60" with 3/8" rod.
 - 2. 3": 60" with 1/2" rod.
 - 3. 4" and 5": 60" with 5/8" rod.
 - 4. 6": 60" with 3/4" rod.
 - 5. 8" to 12": 60" with 7/8" rod.
 - 6. 15": 60" inches with 1" rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

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- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. 1 ½" and 2": 48" with 3/8" rod.
 - 2. 3": 48" with ½" rod.
 - 3. 4" and 5": 48" with 5/8" rod.
 - 4. 6": 48" with ¾" rod.
 - 5. 8" to 12": 48" with 7/8" rod.
- I. Install supports for vertical PVC piping every 48".
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow,

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but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

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

END OF SECTION 221413

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SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. AFF Above Finished Floor.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Provide Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.
- B. Coordinate accessories, extensions, collars, flashing clamps, etc... for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

- A. General-Purpose Roof Drains:

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1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.4, for general-purpose roof drains.
 3. Body Material: Cast iron.
 4. Combination Flashing Ring and Gravel Stop: Required.
 5. Underdeck Clamp: Required.
 6. Sump Receiver Plate: Not required.
 7. Dome Material: Aluminum.
 8. Extension collar required.
- B. Cornice, Sill, and Gutter Roof Drains:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.4, for cornice and gutter roof drains.
 3. Body Material: Metal.
 4. Dimension of Body: Nominal 6-inch diameter.
 5. Dome Material: Bronze.
- C. Canopy Drains:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Basis of Design: Josam 22080-3-26
 3. Standard: ASME A112.6.4, for canopy roof drains.
 4. Body Material: Metal.
 5. Dimension of Body: Nominal 6-inch diameter.
 6. Dome Material: Bronze.
- D. Parapet Roof Drains:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

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- a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for parapet roof drains.
 3. Body Material: Cast iron.
 4. Grate Material: Bronze.

2.2 OVERFLOW ROOF DRAINS

A. General-Purpose Overflow Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Combination Flashing Ring and Gravel Stop: Required.
5. Underdeck Clamp: Required.
6. Sump Receiver Plate: Not required.
7. Dome Material: Aluminum.
8. Extension collar required.

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

B. Storm Drain and Storm Drain Overflow Nozzles:

1. Available manufacturers
 - a. JR Smith Manufacturing
 - b. Josam Company
 - c. Zurn
2. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
3. Size: Same as connected conductor
4. Basis of Design: Josam Series 25010.
5. Product is for use where storm drain piping or secondary storm drain piping exits the building above grade and shall be provided where indicated on the drawings.

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2.4 CLEANOUTS

A. General:

1. Available Manufacturers:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Closure Material: Match pipe, brass, PVC, or ABS

B. Floor Cleanouts:

1. Housing: threaded, adjustable.
2. Type: Threaded, adjustable housing.
3. Body: Cast iron.
4. Outlet Connection: Inside call, Spigot, or Threaded.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Satin finish nikaloy.
7. Frame and Cover Shape: Round or Square (Contractors Option).
8. Top Loading Classification: Extra Heavy Duty.
9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
10. Carpet Ring: Yes for carpeted floors.
11. Tile Recess: Yes for tiled floors.
12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.

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3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains where indicated. Create low points in roof areas according to roof membrane manufacturer's written installation instructions. Install flashing ring, collar, or flange to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
- B. Install downspout boots at grade. Secure to building wall.
- C. Install storm drain and storm drain overflow nozzles at exposed bottom of storm drain and storm drain overflow conductors where they spill onto grade.
- D. Install cleanouts in aboveground piping and building drain piping according to the International Plumbing Code.
- E. Install cleanouts for piping below floors.
- F. Install cleanout deck plates with top flush with finished floor.
- G. For wall cleanouts located in concealed piping, install cleanout wall access covers with cover tight to finished wall.
- H. Install horizontal backwater valves where indicated.
- I. Install concrete slabs at backwater valves.
- J. Install cleanouts in vertical conductors at 18" AFF.
- K. Install access door in wall if required to access cleanout.
- L. Install through-penetration firestop assemblies at penetrations of rated assemblies.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

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3.3 PROTECTION

- A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of open piping at end of each day or when work stops.

END OF SECTION 221423

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SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater proposed. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties and accessories.
- B. LEED Submittal: Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. 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.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

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1.4 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.5 WARRANTY

- A. Warranty: Manufacturer's standard form in which 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 Period from date of Substantial Completion:
 - a. Storage Tank(s): Five years.
 - b. Controls and Other Components: One year.
 - c. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 DOMESTIC-WATER HEATERS

1. General:
 - a. The basis of design for each water heater shall be as indicated. The contractor shall provide equivalent products by one of the listed manufacturers.
2. Manufacturers:
 - a. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - b. Lochinvar Corporation.
 - c. State Industries.
 - d. Laars

2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. The basis of design for each Compression Tank shall be as indicated. The contractor shall provide an equivalent product.
- B. Domestic-Water Compression Tanks:
1. Available Manufacturers:
 - a. AMTROL Inc.
 - b. Honeywell International Inc.
 - c. Pentair Pump Group (The); Myers.

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- d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - e. State Industries.
 - f. Taco, Inc.
 - g. Hubbell
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than ¾" with ASME B1.20.1 pipe threads.
 - D. Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2 Heat-Trap Fitting.
 - E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
 - F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include rating to match gas supply & water heater requirement.
 - G. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank. ANSI Z21.22/CSA 4.4-M or ASME rated and stamped.
 - H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
 - I. Plug and cord:
 - 1. Where water heaters require 120 volt single phase power, provide a plug and cord, for connection to a standard grounded outlet.
 - 2. Cord length: As required to reach outlet, 6'-0" maximum.
 - 3. Plug and cord ampacity shall be approved by the water heater manufacturer.
 - J. Intake Venting:
 - 1. Air Intake Termination: PVC gooseneck elbow with bird screen.
 - 2. CPVC/PVC as recommended by water heater manufacturer.
- 2.3 SOURCE QUALITY CONTROL
- A. Run/fire water heaters prior to shipment.
 - B. Hydrostatically test water heaters and storage tanks to minimum of one and one-half times pressure rating prior to shipment.
 - C. Domestic-water heaters will be considered defective if they leak or do not operate correctly. Comply with requirements in Section "Quality Requirements" for re-testing and re-inspecting requirements and Section "Execution" for requirements for correcting the Work.

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- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base.
 - 1. Maintain manufacturer's recommended clearances.
- B. Install commercial domestic-water heaters with seismic-restraint devices.
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief-valve outlet, with drain piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater tank drain as indicated. Install hose-end drain valves. Comply with requirements for hose-end drain valves specified in Section "Domestic Water Piping Specialties."
- E. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- F. 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 Division 22 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Install heat traps on inlet and outlet piping.
- H. Fill with water.
- I. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section "Domestic Water Piping."
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where installing piping adjacent to water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

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3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

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.
 - 2. Leak Test: After installation, charge system 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 operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section "Quality Requirements" for retesting and reinspecting requirements and Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train. Train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

END OF SECTION 223400

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SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. PMMA: Polymethyl methacrylate (acrylic) plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. RFI: Request for information.
- F. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- G. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- H. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- I. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.
- J. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.
- K. Other Manufacturers: Use one of those listed.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Performance Submittals:
 - 1. Product Data:
 - a. Documentation indicating flow and water consumption requirements.

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1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.
- B. Faucet Cartridges, washers, aerators and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than five (5) of each type and size.
- C. Flushometer Valve Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or six (6), whichever is less.
- D. Provide Minimum number of key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, security fasteners and any fixture where a key, security fastener, or special tool is required:
 - 1. One (1) for ten percent (10%) of each size or ten (10), whichever is less.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. EPA WaterSense: Provide fixtures with WaterSense labeling for all applicable and eligible fixtures and accessories.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following standards and other requirements where applicable:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 6. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 7. Vitreous-China Fixtures: ASME A112.19.2M.
 - 8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 10. Whirlpool Bathtub Fittings: ASME A112.19.8M.

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11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
14. Faucets: ASME A112.18.1.
15. Hose-Connection Vacuum Breakers: ASSE 1011.
16. Hose-Coupling Threads: ASME B1.20.7.
17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
18. NSF Potable-Water Materials: NSF 61.
19. Pipe Threads: ASME B1.20.1.
20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
21. Supply Fittings: ASME A112.18.1.
22. Brass Waste Fittings: ASME A112.18.2.
23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
26. Faucets: ASME A112.18.1.
27. Hand-Held Showers: ASSE 1014.
28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

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1.6 COORDINATION

- A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance. Provide necessary accessories and components for complete installation.
- B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with design.
- C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.
- D. Where fixtures or its associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.
- E. Where the flush valve assembly height would conflict with the rear grab bar installation (including the minimum 1-1/2" clearance to the bottom of the grab bar), the vacuum breaker flush tube shall be shortened. Shortening of the vacuum breaker flush tube shall not exceed the manufacturer's requirements for maintaining proper operation, including the CL (critical line) markings on the flush tube if provided by the manufacturer to indicate shortening limitations.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Cartridges, washers, aerators and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 5 of each type and size.
 - 2. Flushometer Valve, Repair Kits: 5 of each type.

PART 2 - PRODUCTS

2.1 **(EWS-1)** EMERGENCY COMBINATION SHOWER WITH EYE/FACE WASH
(ACCESSIBLE)

- A. Manufacturer & Model Number: Bradley S19314BFPB
 - 1. Barrier-free accessibility.
 - 2. Stainless steel push handle.
 - 3. Eye/Face wash with protective flip up covers.
 - 4. Extended pull rod with triangular handle.
 - 5. Integral flow control in sprayhead assembly.
 - 6. Chrome-plated brass 1/2" IPS stay-open ball valves.
 - 7. Plastic bowl with flip up dust cover.
- B. Emergency Mixing Valve: Bradley Navigator S19-2100-EFX25
 - 1. Adjustable set point with temperature range.
 - 2. Rough bronze finish.
 - 3. Set for 85° F. Supplied by building tepid water supply where applicable.
 - 4. Positive shutoff of hot supply when cold supply is lost.
 - 5. Adjustable high-temperature-stop limits temperature to 90 degrees F.

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6. Equipped with integral check stops on hot and cold supplies and strainers.
 7. Flow Range = 3 GPM at less than 5 PSID – 64 GPM at 45 PSID
- C. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
1. Eye Wash Station
 - a. Guardian
 - b. Haws Corp
 - c. Chicago
 - d. Encon
 2. Mixing Valve
 - a. Guardian
 - b. Lawler Manufacturing Company
 - c. Symmons

2.2 **(EWC-1)** BI-LEVEL WATER COOLER (ACCESSIBLE) WITH BOTTLE FILLING STATION

- A. Manufacturer & Model Number: Elkay LZSTL8WSSP
1. Self-contained wall hung electric refrigerated water cooler
 2. Push bar activation on front, left, & right of unit.
 3. Built-in flow regulator
 4. Connect to water supply using dielectric coupling.
 5. Polyester elastomer flexible bubbler.
 6. Provide non-metallic strainer.
 7. Provide quick connect fittings.
 8. Provide cane apron on upper fountain.
 9. Provide bottle filling station on accessible fountain.
 10. Material: Stainless steel.
 11. Color: Manufacturer's standard.
 12. Electrical: 115V, 1 PH, 60 HZ, 5.0 Full load amps, 370 Watts.
- B. Supply: McGuire Part Number 2165-N3-F
1. ½" IPS x 3/8" OD
 2. ½" x 3" chrome plated brass nipple.
 3. Heavy brass chrome plated wall flange with set-screw
 4. Provide dielectric connection.
- C. Provide 1½" diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.
- D. Trap: McGuire Part Number 8912-C-F
1. Size: 1-1/2" x 1-1/2"
 2. Material: Polished chrome plated cast brass.
 3. Cleanout plug: Yes
 4. Nuts: Polished chrome plated brass.
 5. Wall bend: 17-gauge seamless tubular chrome plated brass.
 6. Wall flange: Chrome plated brass with setscrew. Where drain pipe connection protrudes from wall contractor may provide deep flange.
- E. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

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1. Drinking Fountain:
 - a. Halsey Taylor
 - b. Haws Corp
 - c. Oasis
2. Trap:
 - a. Kohler
 - b. Cambridge Brass

2.3 **(HB-1)** INTERIOR HOSE BIBB

- A. Manufacturer and Model Number: Zurn Z1341XL
 1. Vacuum Breaker: Yes (separate). Zurn Z1399-VB
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. 3/4" Inlet
 4. Ball valve 1/4 turn or compression.
 5. Brass Construction
 6. Aluminum, brass, stainless steel, or steel handle
- B. Available Manufacturers:
 1. Josam
 2. T&S
 3. Chicago
 4. Arrowhead Brass

2.4 **(LA-1)** WALL-HUNG LAVATORY (ACCESSIBLE) WITH MANUAL FAUCET

- A. Manufacturer & Model Number: Zurn Z5310
- B. Material: Vitreous China
- C. Color: White
- D. Faucet: Zurn 81101XL-G-HCT-25M
 1. 4" Spout
 2. 0.50 GPM Maximum Flow
 3. Chrome plate
 4. All Brass Body
 5. Renewable Seat and Washers
 6. Wrist Blade Handles
- E. Drain: McGuire Part Number 155A
- F. Trap: McGuire Part Number 8902C-F
 1. 1-1/4"x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
 2. 17-gauge seamless tubular chrome plated brass wall bend.
 3. Forged brass chrome plated wall flange with setscrew.
- G. Supplies: McGuire Part Number 2165-N3-F
 1. 1/2" IPS x 3/8" OD
 2. 1/2" x 3" chrome plated brass nipple.

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3. Heavy brass chrome plated wall flange with set-screw
 4. Contractor shall coordinate supply connection to faucet.
- H. Insulation: Tru-Bro Lav Guard #102
1. Color: White
 2. Insulate P-trap, hot and cold angle valves, hot and cold risers.
- I. Carrier: Josam Series 17100
1. Floor mounted with rectangular uprights.
- J. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
1. Lavatory
 - a. American Standard
 - b. Eljer
 - c. Gerber
 2. Faucet:
 - a. Speakman
 - b. Cambridge Brass
 - c. T&S Brass
 - d. Moen
 3. Drain:
 - a. Kohler
 - b. Cambridge Brass
 - c. Chicago
 4. Trap:
 - a. Kohler
 - b. Cambridge Brass
 5. Supplies:
 - a. Cambridge Brass
 - b. Kohler
 6. Insulation:
 - a. McGuire
 7. Carrier:
 - a. JR Smith
 - b.

2.5 **(LA-2)** COUNTERTOP LAVATORY (ACCESSIBLE) WITH MANUAL FAUCET

- A. Manufacturer & Model Number: Zurn Z5110
1. With Overflow
 2. 4" Centers
 3. With Sealant
 4. Self rimming
- B. Material: Vitreous China
- C. Color: White
- D. Faucet: Zurn
1. 4" Spout

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2. 0.50 GPM Maximum Flow
 3. Chrome plate
 4. All Brass Body
 5. Renewable Seat and Washers
 6. Wrist Blade Handles
- E. Drain: McGuire Part Number 155A
- F. Trap: McGuire Part Number 8902C-F
1. 1-1/4"x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
 2. 17-gauge seamless tubular chrome plated brass wall bend.
 3. Forged brass chrome plated wall flange with setscrew.
- G. Supplies: McGuire Part Number 2165-N3-F
1. 1/2" IPS x 3/8" OD
 2. 1/2" x 3" chrome plated brass nipple.
 3. Heavy brass chrome plated wall flange with set-screw
 4. Contractor shall coordinate supply connection to faucet.
- H. Insulation: Tru-Bro Lav Guard #102
1. Color: White
 2. Insulate P-trap, hot and cold angle valves, hot and cold risers.
- I. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
1. Lavatory
 - a. American Standard
 - b. Eljer
 - c. Gerber
 2. Faucet:
 - a. Speakman
 - b. Cambridge Brass
 - c. T&S Brass
 - d. Moen
 3. Drain:
 - a. Kohler
 - b. Cambridge Brass
 - c. Chicago
 4. Trap:
 - a. Kohler
 - b. Cambridge Brass
 5. Supplies:
 - a. Cambridge Brass
 - b. Kohler
 6. Insulation:
 - a. McGuire

2.6 **(MB-1)** MOP/SERVICE BASIN

- A. Manufacturer & Model Number: Fiat TSB3002

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- B. Shoulders shall not be less than 9" high inside measurement, and not less than 1" wide. The tiling flange shall be cast integral to the unit and shall extend 1" above the shoulder on 2 sides. Basin shall be composed of marble chips and Portland cement ground smooth and sealed to resist stains. A one piece, 20-gauge, type 302 stainless-steel cap shall be integrally cast into the unit on four sides.
 - 1. Dimensions: 36" x 36" x 12".
 - 2. Cap: Stainless steel on 4 sides.
 - 3. Tiling Flange: Yes on two sides.
 - 4. Material: Terrazzo
 - 5. Color: Manufacturer's standard
- C. Faucet: Zurn Z843M4-XL-CS-HCT
 - 1. 8" center
 - 2. Vacuum breaker spout
 - 3. Lever Handles
 - 4. Integral supply check stops
 - 5. Pail hook
 - 6. Wall support
- D. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.
- E. Trap: 3" (Provide additional pipe and material transition as required make connection to sink)
- F. Stainless utility shelf with mop/broom holders and rag hooks: Bobrick Model B-239
- G. Provide the following other Accessories
 - 1. Hose Hook
 - 2. 36" long hose
- H. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - 1. Service Sink
 - a. Fiat
 - b. Just
 - c. Florestone
 - 2. Faucet:
 - a. T&S
 - b. Water Saver
 - c. Royal Brass
 - d. Speakman
 - e. Moen

2.7 **(RH-1)** ROOF HYDRANT FREEZE-RESISTANT

- A. Manufacturer & Model Number: Zurn Z1388XL-AC-VB non-freeze.
- B. General: Cast bronze, non-freeze, roof hydrant with aluminum casing, manual lockable lever handle, and integral vacuum breaker/backflow preventer. Pressure rating shall be 125 psig. Comply with ASME A112.21.3M, ASSE 1011, and ASSE 1019. Provide self-draining integral non-removable hose-connection, and clamping collar.
 - 1. Inlet: 3/4" threaded or solder joint.
 - 2. Outlet: ASME B1.20.7, garden-hose threads.

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3. Drain Port: Extend drain port to nearest approved termination point.

C. Other Manufacturers:

1. Josam
2. Smith
3. Woodford
4. Zurn

2.8 **(SH-1, SH-2, & SH-3) INDIVIDUAL SHOWER (ACCESSIBLE)**

A. Manufacturer & Model Number: Resinous coating by architectural.

B. Shower Valve: Zurn Z7301-SS-MT-DV2P-HW-H9-S9

1. Temperature and pressure balanced valve
2. ASSE-1016
3. Fixed shower head
4. Hand held shower set with 60" flex hose
5. 30" Slide bar for hand held shower mounted with stainless steel plates and bolts
6. Diverting valve
7. Integral service check stops

C. Provide one (1) outside white cotton shower curtain and one (1) inside vinyl curtain liner.

D. Provide chrome plated brass curtain rod and flanges.

E. Provide two (2) sets of rollerball type shower curtain hooks.

F. Provide self-sealing brass drain and strainer.

G. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Tiled shower enclosure by architectural.
2. Shower Valve
 - a. Leonard
 - b. Bradley
 - c. Moen
 - d. Symmons

2.9 **(SK-1) KITCHENETTE SINK (ACCESSIBLE) – SINGLE BOWL**

A. Manufacturer & Model Number: Elkay LRADQ-221955

1. Overall Length (left to right): 22"
2. Overall Width (front to back): 19-1/2"
3. Inside Bowl Depth: 5-1/2"
4. Material: 18 Gauge Stainless Steel
5. Number of Bowls: 1
6. Drain location: Off-center, rear.
7. Mounting: Inside hole ratchet system equal to Elkay Quick-Clip® mounting system. Systems requiring access from below shall not be permitted.
8. Deck Hole drilling configuration:
 - a. 3 holes, 4" apart, centered.

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- B. Faucet: Zurn Z82300-XL-CP4-3M
1. Hole configuration: 3 Hole installation, 4" centers.
 2. Spout: 10" Gooseneck swing spout.
 3. Handles: Single lever
 4. Aerator: Vandal-resistant, pressure-compensating, 0.50 gpm
 5. Cartridges: Ceramic or compression ¼ turn.
 6. Meets ADA requirements: Yes
 7. Other:
 - a. Red & blue temperature indicators. Red = Hot, blue = cold.
- C. Basket Strainer & Tail Piece: McGuire Part Number 151
1. Material: Forged brass, chrome plated.
 2. Tailpiece: 1-1/2" x 4" 20 gauge seamless brass, chrome plated.
 3. Nuts: Cast brass lock, slip, and coupling, chrome plated
- D. Trap: McGuire Part Number 8912-C-F
1. Size: 1-1/2" x 1-1/2"
 2. Material: Polished chrome plated cast brass.
 3. Cleanout plug: Yes
 4. Nuts: Polished chrome plated brass.
 5. Wall bend: 17-gauge seamless tubular chrome plated brass.
 6. Wall flange: Chrome plated brass with setscrew. Where pipe protrudes from wall contractor may provide deep flange.
- E. Supplies: McGuire Part Number 2167-N3-F
1. Inlet: ½" IPS
 2. Outlet: ½" OD compression.
 3. Nipple: ½" x 3" chrome plated brass.
 4. Wall flange: Heavy brass chrome plated with set-screw
- F. Insulation: Tru-Bro Lav Guard #102
1. Insulate P-trap, hot and cold angle valves, hot and cold risers.
- G. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
1. Sink
 - a. Kohler
 - b. Just
 - c. Eagle Group
 2. Faucet:
 - a. Speakman
 - b. Cambridge Brass
 - c. T&S Brass
 - d. Moen
 3. Basket Strainer & Tail Piece:
 - a. Kohler
 - b. Cambridge Brass
 4. Trap:
 - a. Kohler
 - b. Cambridge Brass

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5. Supplies:
 - a. Chicago
 - b. Cambridge Brass
 - c. T&S

2.10 **(SK-2)** STAINLESS STEEL UTILITY SINK

- A. Manufacturer & Model Number: Elkay WNSF81302
- B. General: Stainless steel unit with stainless steel legs and backsplash.
 1. Material: 14 Gauge Stainless Steel
 2. Overall Length (Right to Left): 33"
 3. Overall Width (Front to Back): 27-1/2"
 4. Inside Bowl Depth: 14"
 5. Rim: 36"
- C. Faucet: Zurn Z842H1-XL-HCT-3F
 1. Hole configuration: 2 Hole installation, 8" centers.
 2. Spout: 8" tubular swing spout with adjustable swing limits.
 3. Handles: Levers.
 4. Aerator: Vandal-resistant, pressure-compensating, 0.50 gpm
 5. Cartridges: Ceramic or compression ¼ turn.
 6. Meets ADA requirements: Yes
 7. Other:
 - a. Red & blue temperature indicators. Red = Hot, blue = cold.
- D. Supplies:
 1. Manufacturer & Model Number: McGuire 2167-N3-F
 - a. Inlet: ½" IPS
 - b. Outlet: ½" OD compression.
 - c. Nipple: ½" x 3" chrome plated brass.
 - d. Wall flange: Heavy brass chrome plated with set-screw
- E. Drain: McGuire Part Number 152N
 1. Brass basket strainer with 4" long 1-1/2" diameter 17 gage tailpiece.
- F. Trap: McGuire Part Number 8912-C-F
 1. Size: 1-1/2" x 1-1/2"
 2. Material: Polished chrome plated cast brass.
 3. Cleanout plug: Yes
 4. Nuts: Polished chrome plated brass.
 5. Wall bend: 17-gauge seamless tubular chrome plated brass.
 6. Wall flange: Chrome plated brass with setscrew. Where pipe protrudes from wall contractor may provide deep flange.
- G. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 1. Sink
 - a. Swan Corporation
 - b. Crane
 2. Faucet:

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- a. T&S
- b. Speakman
- c. Moen
- 3. Drain:
 - a. Kohler
 - b. Cambridge Brass
- 4. Trap:
 - a. Kohler
 - b. Cambridge Brass

2.11 **(UR-1)** URINAL (ACCESSIBLE) WITH MANUAL FLUSH VALVE

- A. Manufacturer & Model Number: Zurn Z5755 (0.125 Gallon Flush)
- B. Material: Vitreous china
- C. Color: White
- D. Flush Valve: Zurn Z6003AV-ULF (0.125 Gallon Flush)
 - 1. Supply Rough-in Elevation: 11-1/2" above spud connection
 - 2. Provide:
 - a. Accessible handle located on wide side of approach..
 - b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
 - c. Vandal Resistant Stop Cap with Set Screw.
- E. Carrier: Josam Series 17560-UR.
 - 1. Options
 - a. Provide components for thicker walls when required.
 - b. Provide valve plate for attaching to upright.
- F. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - 1. Urinal
 - a. American Standard
 - b. Eljer
 - c. Crane
 - d. Gerber
 - 2. Flush Valve
 - a. Delany
 - b. Zurn
 - c. Moen
 - d. Sloan

2.12 **(WC-1)** FLOOR MOUNTED WATER CLOSET (ACCESSIBLE) WITH MANUAL DIAPHRAM TYPE FLUSH VALVE

- A. Manufacturer & Model Number: Zurn Z5665-BWL1-AM (1.28 Gallon Flush)
- B. Material: Vitreous china
- C. Color: White
- D. Flush Valve: Zurn Z6000AV-HET (1.28 Gallon Flush)

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1. Supply Rough-in Elevation: 11-1/2" above spud connection
 2. Provide:
 - a. Accessible handle located on wide side of approach.
 - b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
- E. Seat: Church 9500SSCT (White)
1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.
- F. Manufacturers:
1. Water Closet
 - a. American Standard
 - b. Eljer
 - c. Crane
 - d. Gerber
 - e. Sloan
 - f. Zurn
 2. Flush Valve:
 - a. Delany
 - b. Zurn
 - c. Moen
 - d. Sloan
 3. Seat
 - a. Olsonite
 - b. Centoco
- 2.13 **(WC-2)** FLOOR MOUNTED WATER CLOSET WITH MANUAL DIAPHRAM TYPE FLUSH VALVE
- A. Manufacturer & Model Number: Zurn Z5655-BWL1-AM (1.28 Gallon Flush)
1. Material: Vitreous china
 2. Color: White
- B. Flush Valve: Zurn Z6000AV-HET (1.28 Gallon Flush)
1. Supply Rough-in Elevation: 11-1/2" above spud connection
 2. Provide:
 - a. Accessible handle located on wide side of approach.
 - b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
- C. Seat: Church 9500SSCT (White)
1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.
- D. Manufacturers:
1. Water Closet
 - a. American Standard
 - b. Eljer
 - c. Crane
 - d. Gerber
 2. Flush Valve:
 - a. Delany

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- b. Zurn
- c. Moen
- d. Sloan
- 3. Seat
 - a. Olsonite
 - b. Centoco

2.14 **(WH-1)** WALL HYDRANT – FREEZE PROOF

- A. Manufacturer & Model Number: Zurn Z1320XL-CL-WC non-freeze with flush recessed wall box.
- B. General: Cast bronze, non-freeze, wall hydrant with cast bronze box, satin finish face, hinged latching cover, control key, and integral vacuum breaker/backflow preventer. Pressure rating shall be 125 psig. Comply with ASME A112.21.3M, ASSE 1011, and ASSE 1019. Provide self-draining integral non-removable hose-connection, and wall clamp.
 - 1. Inlet: ¾" threaded or solder joint.
 - 2. Outlet: ASME B1.20.7, garden-hose threads.
 - 3. Operating Keys: One with each hydrant.
- C. Other Manufacturers:
 - 1. Smith
 - 2. Woodford
 - 3. Zurn

2.15 **(WSB-1)** WATER SUPPLY OUTLET BOX

- A. Manufacturer & Model: Guy Gray BIM875QTSAB
- B. General: Recessed-mounting, 20-gauge steel, outlet box& faceplate with supply fitting complying with ASME A112.18.1M. Include box with faceplate, supply valve, and reinforcement
- C. Supply valve: ½" IPS (or copper sweat) x 3/8" OD
- D. Available Manufacturers
 - 1. Oatey
 - 2. Water-Tite
 - 3. LSP Products Group.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.

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- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
- C. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounted fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".
- J. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. 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.
- R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- S. Install traps on fixture outlets.

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1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- U. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.
- V. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results For Plumbing" for escutcheons.
- W. Set **[bathtubs,] [shower receptors,] [and] [service basins]** in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results For Plumbing" for grout.
- X. Refer to Section "Joint Sealants" for sealant and installation requirements.
- Y. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

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3.5 ADJUSTING

- A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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SECTION 224600 – SECURITY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. PMMA: Polymethyl methacrylate (acrylic) plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. RFI: Request for information.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Accessible Service Space: Service area in secure space behind wall-mounted fixtures.
- C. Back-Access Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall or on wall, so installation and removal of fixture, piping, and other components are accessible only from service space behind wall.
- D. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- E. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- F. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.
- G. Front Access Fixture: Security plumbing fixture designed to mount on wall with installation and removal from fixture side of wall, and with piping and other components accessible only from access panel in fixture.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

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I. Other Manufacturers: Use one of those listed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Performance Submittals:

1. Product Data: Documentation indicating flow and water consumption requirements.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.

B. Faucet Cartridges, washers, aerators and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than five (5) of each type and size.

C. Flushometer Valve Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or six (6), whichever is less.

D. Provide one (1) for ten percent (10%) of each size or ten (10), whichever is less key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, [security fasteners] and any fixture where a key, [security fastener,] or special tool is required.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.

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- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following standards and other requirements where applicable:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 6. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 7. Vitreous-China Fixtures: ASME A112.19.2M.
 - 8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 10. Whirlpool Bathtub Fittings: ASME A112.19.8M.
 - 11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 14. Faucets: ASME A112.18.1.
 - 15. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 16. Hose-Coupling Threads: ASME B1.20.7.
 - 17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 18. NSF Potable-Water Materials: NSF 61.
 - 19. Pipe Threads: ASME B1.20.1.
 - 20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 21. Supply Fittings: ASME A112.18.1.
 - 22. Brass Waste Fittings: ASME A112.18.2.
 - 23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 - 26. Faucets: ASME A112.18.1.
 - 27. Hand-Held Showers: ASSE 1014.
 - 28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.

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29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

1.7 COORDINATION

- A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance. Provide necessary accessories and components for complete installation.
- B. Coordinate roughing-in, final plumbing fixture locations, and verify that fixtures can be installed to comply with design.

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- C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.
- D. Where fixtures or its associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.
- E. Where the flush valve assembly height would conflict with the rear grab bar installation (including the minimum 1-1/2" clearance to the bottom of the grab bar), the vacuum breaker flush tube shall be shortened. Shortening of the vacuum breaker flush tube shall not exceed the manufacturer's requirements for maintaining proper operation, including the CL (critical line) markings on the flush tube if provided by the manufacturer to indicate shortening limitations.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. All exposed fasteners shall be security fasteners.

2.2 **S-1A STAINLESS STEEL SECURITY COMBI-UNIT (ACCESSIBLE)**

A. Basis-of-Design Product:

- 1. Provide Willoughby Series 4896 Ligature-resistant combination unit, Handicap-ADA compliant, back-mounting, rear access, security water closet/lavatory; fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- 2. Water Closet/Lavatory:
 - a. Unit:
 - 1) Left or Right hand configuration. See plans
 - 2) ECW - Wall outlet
 - 3) WS - Wall sleeve
 - 4) PBH - Ligature resistant pneumatic push buttons
 - 5) BC - Code bubbler/filler (w/mouth guard)
 - 6) PC3 - Pinned cleanout plug
 - 7) OV - Lavatory overflow
 - 8) PML2 - Dual temp pneumatic metering lavatory valve
 - 9) T4A - Toilet overflow preventer with auto reset
 - 10) TWE - 3" PVC toilet waste extension connection
 - 11) TWC3P - 3" PVC toilet waste coupling
 - 12) LWE - 1 1/2" PVC lavatory waste extension connection
 - 13) HPS - High polish seat
 - 14) Toilet shipping cover
 - b. Flush Valve: Willoughby/Sloan Flush Valve (1.6 Gal. Flush)
 - c. Refer to plans for orientation.
 - 1) Wall Sleeve: Galvanized-steel frame of dimensions required to match and sup-

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port entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.

3. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
4. Other Manufacturers:
 - a. Fixture:
 - 1) Acorn
 - 2) Bradley
 - b. Flush Valve:
 - 1) Sloan
 - 2) Zurn

2.3 **S-1B STAINLESS STEEL SECURITY COMBI-UNIT**

A. Basis-of-Design Product:

1. Description: Provide Willoughby Series 1546 combination unit, back-mounting, rear access, security water closet/lavatory; fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Water Closet/Lavatory:
 - a. Unit:
 - 1) PWA-1: Center configuration
 - 2) PWA-3: Left or Right hand configuration. See plans
 - 3) ECW - Wall outlet
 - 4) WS - Wall sleeve
 - 5) PBH - Ligature resistant pneumatic push buttons
 - 6) BC - Code bubbler/filler (w/mouth guard)
 - 7) PC3 - Pinned cleanout plug
 - 8) OV - Lavatory overflow
 - 9) PML2 - Dual temp pneumatic metering lavatory valve
 - 10) T4A - Toilet overflow preventer with auto reset
 - 11) RTH - Recessed tissue holder
 - 12) TWE - 3" PVC toilet waste extension connection
 - 13) TWC3P - 3" PVC toilet waste coupling
 - 14) LWE - 1 1/2" PVC lavatory waste extension connection
 - 15) HPS - High polish seat
 - 16) Toilet shipping cover
 - b. Flush Valve: Willoughby/Sloan Flush Valve (1.6 Gal. Flush)
 - c. Refer to plans for orientation.
3. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.

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4. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
5. Other Manufacturers:
 - a. Fixture:
 - 1) Acorn
 - 2) Bradley
 - b. Flush Valve:
 - 1) Sloan
 - 2) Zurn

2.4 S-1C STAINLESS STEEL SECURITY WATER CLOSET (ACCESSIBLE)

A. Basis-of-Design Product:

1. Provide Willoughby ETW-1490-FM-HC front access, wall outlet, floor mounted blowout series security water closet; fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Water Closet:
 - a. Unit:
 - 1) ECW - On-floor mounting-wall outlet
 - 2) WS - Wall sleeve
 - 3) PBH – Ligature resistant pneumatic push buttons
 - 4) PC3 - Pinned cleanout plug
 - 5) T4A - Toilet overflow preventer with auto reset
 - 6) TWE - 3” PVC toilet waste extension connection
 - 7) TWC3P – 3” PVC toilet waste coupling
 - 8) HPS – High polish seat
 - 9) Toilet shipping cover
 - b. Flush Valve: Willoughby/Sloan Flush Valve (1.6 Gal. Flush)
 - c. Refer to plans for orientation.
 - 1) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.
3. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
4. Other Manufacturers:
 - a. Fixture:
 - 1) Acorn
 - 2) Bradley
 - b. Flush Valve:
 - 1) Sloan

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2) Zurn

2.5 S-1D ANGLED STAINLESS STEEL SECURITY COMBI-UNIT (ACCESSIBLE)

A. Basis-of-Design Product:

1. Provide Willoughby Series 1545 Combination unit for 45 degree chase, Handicap-ADA compliant, back-mounting, rear access, security water closet/lavatory; fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
2. Water Closet/Lavatory:
 - a. Unit:
 - 1) Left or right hand configuration. See plans
 - 2) ECW - Wall outlet
 - 3) WS - Wall sleeve
 - 4) PBH - Ligature resistant pneumatic push buttons
 - 5) BC - Code bubbler/filler (w/mouth guard)
 - 6) PC3 - Pinned cleanout plug
 - 7) OV - Lavatory overflow
 - 8) PML2 - Dual temp pneumatic metering lavatory valve
 - 9) T4A - Toilet overflow preventer with auto reset
 - 10) TWE - 3" PVC toilet waste extension connection
 - 11) TWC3P - 3" PVC toilet waste coupling
 - 12) LWE - 1 1/2" PVC lavatory waste extension connection
 - 13) HPS - High polish seat
 - 14) Toilet shipping cover
 - b. Flush Valve: Willoughby/Sloan Flush Valve (1.6 Gal. Flush)
 - c. Refer to plans for orientation.
 - 1) Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.
3. Joint Sealant:
 - a. Place security (Dynaflex or equal, slightly flexible) caulk around the entire fixture interface as it touches either the floor or wall.
4. Other Manufacturers:
 - a. Fixture:
 - 1) Acorn
 - 2) Bradley
 - b. Flush Valve:
 - 1) Sloan
 - 2) Zurn
 - 3)

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2.6 S-2A SECURITY SHOWER (ACCESSIBLE)

1. Basis-of-Design Product:

Description: Provide Willoughby model CWRS-FA-ADA front mounted, front access, recessed shower panel in tile wall.

- a. CSH – Ligature resistant shower head
- b. 1.5 GPM controlled flow rate
- c. RD - Recessed soap dish
- d. PML2 - Dual temp pneumatic metering
- e. PBH – Ligature resistant pneumatic push buttons
- f. Shower head/push button orientation. See plans.

B. Material: 304 Stainless steel for fixture.

C. Valve: Willoughby series PML2 dual temperature lead-free pneumatic valve.

1. Valve shall contain non-corrosive wet parts.

2. Include the following:

- a. Air-control single temperature valves.
- b. Check-stop and strainer assembly for each valve.
- c. Pneumatic push-button for each valve controller.
- d. Cycle interrupt: Allows the user to interrupt the cycle by pushing the fixture pushbutton.

3. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

- 1) Acorn

2.7 S-2B SECURITY SHOWER

1. Basis-of-Design Product:

Description: Provide Willoughby model CWRS-FA front mounted, front access, recessed shower panel in tile wall.

- a. CSH – Ligature resistant shower head
- b. 1.5 GPM controlled flow rate
- c. RD - Recessed soap dish
- d. PML2 - Dual temp pneumatic metering
- e. PBH – Ligature resistant pneumatic push buttons
- f. Shower head/push button orientation. See plans.

B. Material: 304 Stainless steel for fixture.

C. Valve: Willoughby series PML2 dual temperature lead-free pneumatic valve.

1. Valve shall contain non-corrosive wet parts.

2. Include the following:

- a. Air-control single temperature valves.

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- b. Check-stop and strainer assembly for each valve.
 - c. Pneumatic push-button for each valve controller.
 - d. Cycle interrupt: Allows the user to interrupt the cycle by pushing the fixture pushbutton.
3. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
- 1) Acorn

2.8 S-3A SECURITY LAVATORY (ACCESSIBLE)

A. Basis-of-Design Product:

- 1. Description: Provide Willoughby model ES-1015-96-HC-FA 18" wide front access handicap-ADA compliant security lavatory, back-mounting, fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - a. Lavatory:
 - 1) Lavatory:
 - a) PBH – Ligature resistant pneumatic push buttons
 - b) BC – Code Bubbler/Filler
 - c) OV - Overflow

2.9 S-DT1 SECURITY DETOX TOILET

- A. Description: Provide Willoughby model FD-1400 Blowout Type Detox Toilet Floor-mounting, security plumbing fixture fabricated from 14 gauge thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
- B. Water Closet:
 - 1. In-floor mounting-with 3" floor outlet.
- C. Flush Valve: Willoughby/Sloan Flush Valve (1.6 Gal. Flush)
 - 1. Willoughby model RFVB stainless steel Remote Flush Valve Box with integral non-hold open type hydraulic flush valve. Cover shall have security screws with push button flush.
- D. Warranty: Manufacturer's standard warranty with an additional 10 year warranty against dezincification in all water conditions. This warranty shall be non-prorated and shall be provided in writing from the manufacturer.

2.10 SECURITY FASTENERS

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- A. Refer to section Common Work Results for Plumbing Piping.

PART 3 - EXECUTION

3.1 JOINT SEALANT

- A. All fixtures require joint sealant.
- B. Identify and coordinate the filling of all interfaces, under the Contract, between all fixtures, equipment, embeds and other physical items and building components. Refer to specification Section Joint Sealants and its article on "SECURITY SEALANTS" for the types of sealants to be utilized, e.g. Elastomeric Security Sealant similar to Dynaflex , by Pecora Corp and Low-Mod Gel Security Sealant similar to Dynapoxy EP-1200, by Pecora Corp.
- C. Fill all interfaces between fixtures and building components creating a minimum ¼" bead. Bead shall be neat and workman like in appearance as judged by the architect's representative.

3.2 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
- C. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounted fixtures in and attached to casework.

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- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".
- J. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. 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.
- R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- S. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- U. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.
- V. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results For Plumbing" for escutcheons.
- W. Set [bathtubs,] [shower receptors,] [and] [service basins] in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results For Plumbing" for grout.

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- X. Refer to Section "Joint Sealants" for sealant and installation requirements.
- Y. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 ADJUSTING

- A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

3.7 CLEANING

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- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.8 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100

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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

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1.4 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the applicable building codes shall be listed and labeled in accordance with the current edition of those codes.
- B. Equipment and appliances comprising portions of the mechanical systems shall be installed in accordance with the listing, manufacturer's installation instructions, and the applicable building codes. Manufacturer's installation instructions shall be available on the job site for use and inspection.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 INTENT OF CONTRACT DOCUMENTS

- A. Mechanical and HVAC drawings are diagrammatic, indicating general locations and arrangements of pipe, duct, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.
- D. Indicated configurations were used to size pipes, fans, pumps, expansion tanks and other devices. Install piping, duct, and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for

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approval by the Architect's representative. Additional fittings and offsets not indicated are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to Section "Hydronic Piping" for additional pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping sections for joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, non-metallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

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- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

- A. Manufacturer: Victaulic
- B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, 2 bolts and 2 nuts.
- C. Gasket Material: Grade "E" EPDM suitable for use up to 250°F.
- D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epcos Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

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E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.

1. Available Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Metraflex Co.
- d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.9 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Fastener: Provide **torx-head** (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish: Finish shall match that specified of the item anchored.
 - 3. Tools: Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following and Division 23 Sections specifying piping systems.

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- 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.
- D. Install piping above accessible ceilings allowing sufficient space for ceiling panel removal.
- E. Install piping to permit valve operation & servicing.
- F. Install condensate drain piping at 1% slope.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections unless otherwise indicated.
- I. Install piping leaving room for installation of insulation.
- J. Install system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - 2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
 - 3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - 4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
 - 5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
 - 6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
 - 7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
 - 8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below.
- L. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- M. Sleeves are not required for core-drilled holes.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

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- O. Install sleeves for pipes passing through walls, floors, or roofs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment rooms, fan rooms or other similar wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
 - 2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: Permitted for pipes smaller than 6" except aboveground, exterior-walls.
 - b. Steel Sheet Sleeves: Permitted for pipes 6" and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
 - c. Seal space outside sleeve fittings with grout and sealant.
 - 3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section "Joint Sealants".
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - 4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
- R. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.

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- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.
- E. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.
- F. Threaded Joints: Thread pipe with tapered pipe threads. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless otherwise indicated.
- G. Welded Joints: Construct joints using qualified processes and welding operators.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
 - 3. Install dielectric unions or flanges for connections of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

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- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to service side of equipment.
- D. Install equipment to allow space for other systems.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.
 - 1. Construct concrete pads in accordance with drawing details.
 - 2. Details may be found on structural drawings. If details are not provided comply with the following:
 - a. Housekeeping pads inside the building shall be 6" thick and 6" larger all around than supported equipment. Provide #4 rebar at 12" on center each way at mid-depth of slab. Provide a 3/4" chamfer on all edges.
 - b. Equipment pads outside the building shall be 8" thick with a 12" deep and 20" wide turndown (footing) all around the outside edge of the pad. Provide #5 rebar at 16" on center each way at mid-depth of slab. Pad shall be 6" larger all around than supported equipment.
 - c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
 - d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
 - e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
 - f. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
 - h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section "Metal Fabrications" for structural steel.

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- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

3.10 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
 - 1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 - 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 - 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 - 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 - 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

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END OF SECTION 230500

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SECTION 230513 – MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. All motors are required to be equipped with overload protection located near the motor.
 - 1. Overload protection shall:
 - a. Be located between the circuit breaker or fuse provided under Division 26 and the motor windings.
 - b. Meet one of the options specified in the following paragraph.
 - 2. Overload protection may be:
 - a. Located in the motor installed by the motor manufacturer. (preferred)
 - b. A separate device located near the motor.
 - c. Located in, or with, a disconnect switch provided by the equipment manufacturer. Provision of this switch shall not modify, change, or eliminate any Division 26 requirement. This means some equipment shall be provided or specified with two disconnecting means.
- B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with controller
 - 2. Matched to torque and horsepower requirements of the load.
 - 3. Matched to ratings and characteristics of supply circuit and required control sequence.
- C. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- D. Belt tension must be wrench and socket adjustable.
- E. Belt tensioning device must accommodate adjustable sheaves.

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PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply except as follows:
1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
 2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

- A. Frequency Rating: 60 Hz.
- B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- C. Duty: Continuous at 105 deg F and 3300 feet above sea level.
- D. Capacity and Torque sufficient to:
1. Start, accelerate, and operate connected load.
 2. Maintain designated speeds.
 3. Operate at installed altitude and environment.
 4. Operate with indicated operating sequence.
 5. Operate without exceeding nameplate ratings.
 6. Operate without utilizing service factor.
- E. Enclosure: Open drip-proof unless otherwise indicated.
- F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. NEMA Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7

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40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

- C. Efficiency: NEMA Premium
- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- M. Motors Used with Variable Speed Drives: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium Efficiency Motors: Class B temperature rise, Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise, Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally-protected motors.
 - 5. Shaft Grounding: Provide AEGIS bearing protection ring or approved equal.
 - a. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings.
 - b. Motors up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
 - c. Grounding rings shall be provided and installed by the motor manufacturer in accordance with the shaft grounding ring manufacturer's recommendations.
- N. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

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1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.
2. Demonstrate correct rotation, alignment, and speed.
3. Test interlocks and control features for proper operation.
4. Verify that current in each phase is within nameplate rating.
5. Verify RPM is in accordance with nameplate.
6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

A. Align motors, bases, and shafts.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230513

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SECTION 230514 – VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Factory Installed Variable Speed Drive: A drive installed by motorized-equipment manufacturer as a component of equipment utilized to control the speed of a motor.
- B. Field-Installed Variable Speed Drive: A drive installed in the field by the contractor to control the speed of a motor not equipped with a factory installed drive.
- C. VSD: Variable Speed Drive

1.3 SUBMITTALS

- A. Submittals shall include the following information:
 - 1. Outline dimensions
 - 2. Conduit entry locations
 - 3. Weight.
- B. Customer connection and power wiring diagrams.
- C. Technical product description including but not limited to a complete list of options.
- D. Compliance with IEEE 519 – Provide a harmonic analysis specific to the project including total harmonic voltage distortion and total harmonic current distortion (TDD). Analysis shall include all HVAC loads and all equipment with VFDs.
- E. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Provide additional harmonic filtration devices as required to achieve a total harmonic voltage distortion of less than 5%.
- F. All VFDs shall include a minimum of 5% impedance reactors.

1.4 QUALITY ASSURANCE

- A. VSDs and options shall be UL listed as a complete assembly.
- B. The base VSD shall be UL listed for 100 KAIC without the need for input fuses.

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- C. The VSD shall be tested by the manufacturer.
- D. All optional features shall be functionally tested at the factory for proper operation.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with UL 508C.
- F. Referenced standards:
 - 1. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. UL508C
 - 3. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1, 2 and 3NEC 430.120, Adjustable-Speed Drive Systems
 - 5. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156
- G. All VSDs installed on this project shall be from the same manufacturer.
- H. The VSD enclosure shall be seismically certified and labeled in accordance with the IBC 2012 International Building Code:
 - 1. VSD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
 - 2. A Seismic importance factor of 1.5 shall be used and shall be based upon actual shake test data as defined by ICC AC-156. Seismic ratings based upon calculations alone are not acceptable.
 - 3. Certification of Seismic rating must be based on testing done in all three axis of motion by a certified lab.
- I. Installations in life safety applications including but not limited to smoke removal and make up air to smoke removal systems shall be included in the seismic approval.

1.5 WARRANTY

- A. The VSD shall be warranted by the manufacturer for a period of 2 Years from Date of Substantial Completion. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VSD manufacturer.

1.6 COORDINATION

- A. Coordinate features of VSDs with motors, installed units, and accessory devices. Provide VSDs that meet the requirements indicated in this and other equipment specific specification sections.
- B. Confirm that motors controlled by VSDs, provided under this section are designed and labeled for use with variable speed drives, and suitable for use throughout speed range without overheating.

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- C. Coordinate VSD support with requirements for maintenance and replacement; and installation of accessories.

PART 2 - PRODUCTS

2.1 FACTORY INSTALLED VARIABLE SPEED DRIVES

- A. The VSD shall be enclosed in a UL Listed enclosure.
- B. Refer to equipment specific specification sections.
- C. Where equipment specific specification sections do not indicate variable speed drive requirements comply with 2.2 below.

2.2 FIELD-INSTALLED VARIABLE SPEED DRIVES

- A. Manufacturers
 - 1. Basis of Design – ABB
 - 2. Yaskawa
 - 3. Danfoss-Graham
- B. General
 - 1. Furnish complete variable speed drives (VSDs) as indicated.
 - 2. Drawing schedules, sequences of control, control diagrams, details, or other specification sections may indicate variable speed requirements.
 - 3. All standard and optional features shall be included within the VSD enclosure, unless indicated otherwise. Each VSD shall be housed in a NEMA 1 enclosure, or other NEMA type according to installation and operating conditions.
 - 4. Provide NEMA 3R weatherproof enclosures for drives mounted outside.
 - 5. The UL listing shall allow mounting in a plenum or other air handling compartment. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer shall supply a NEMA 12 rated VSD.
 - 6. A bypass is not required unless indicated otherwise.
- C. The VSD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current. Operation shall be suitable for centrifugal pump and fan control and shall eliminate the need for motor de-rating.
- D. With the motor's rated voltage applied to the VSD input, the VSD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VSDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

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- E. The VSD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- F. The VSD and options shall be tested to ANSI/UL Standard 508. The complete VSD, including all specified options, shall be assembled by the manufacturer and shall be UL-508 certified for the building and drive assembly including options. Assembly of the options by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VSD and option panel, in the case where these are not contained in one panel.
- G. The VSD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VSDs without DC link reactors shall provide a minimum 3% impedance line reactor.
- H. The VSD's full load amp rating shall meet or exceed NEC Table 430-150. The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- I. The VSD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
- J. An automatic energy optimization selection feature shall be provided standard in the VSD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- K. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VSD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- L. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
- M. Galvanic and/or optical isolation shall be provided between the VSD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VSDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- N. VSD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VSD efficiencies while reducing motor noise.
- O. Protective Features:
 - 1. Disconnect with drive fusing.
 - 2. A minimum of Class 20 I²t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.

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3. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VSD overtemperature and motor overtemperature. The VSD shall display all faults in plain English. Codes are not acceptable.
4. Protect VSD from sustained power or phase loss. The VSD shall provide full rated output with an input voltage as low as 90% of the nominal. The VSD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, and 313 V AC for 460 volt units.
5. The VSD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
6. VSD package shall include semi-conductor rated input fuses to protect power components.
7. To prevent breakdown of the motor winding insulation, the VSD shall be designed to comply with IEC Part 34-17. Otherwise, the VSD manufacturer must ensure that inverter rated motors are supplied.
8. VSD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
9. VSD shall function normally when the keypad is removed while the VSD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
10. VSD shall catch a rotating motor operating forward or reverse up to full speed.
11. VSD shall be rated for 100,000 amp interrupting capacity (AIC).
12. VSD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VSD will identify which of the output phases is low or lost.
13. VSD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VSDs, and 539 V AC on 460 volt VSDs.

P. Interface Features:

1. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VSD and determine the speed reference.
2. The VSD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VSD is in Auto/Remote mode.
3. The VSD shall provide potentiometer speed control. Electronic speed controls are not acceptable.
4. Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
5. The keypads for all sizes of VSDs shall be identical and interchangeable.
6. To set up multiple VSDs, it shall be possible to upload all setup parameters to the VSD's keypad, place that keypad on all other VSDs in turn and download the setup parameters to each VSD. To facilitate setting up VSDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
7. Display shall be programmable to display in 9 languages including English, Spanish and French.
8. The display shall have four lines, with 20 characters on three lines and eight large characters on one line.
9. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VSD when the keypad is removed.

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10. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VSD eliminating the need for macros.
11. The VSD shall include a standard RS-485 communications port.
12. As a minimum, the following points shall be controlled and/or accessible:
 - a. VSD Start/Stop
 - b. Speed reference
 - c. Fault diagnostics
 - d. Meter points
 - e. Motor power in HP
 - f. Motor power in kW
 - g. Motor kW-hr
 - h. Motor current
 - i. Motor voltage
 - j. Hours run
 - k. Feedback signal #1
 - l. Feedback signal #2
 - m. DC link voltage
 - n. Thermal load on motor
 - o. Thermal load on VSD
 - p. Heat sink temperature
13. Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VSD.
14. LonWorks communication shall be available for factory or field installation within the VSD.
15. Two set-point control interface (PID control) shall be standard in the unit. VSD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
16. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
17. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VSDs unable to show these four displays simultaneously shall provide panel meters.
18. Sleep mode shall be provided to automatically stop the VSD when its speed drops below set "sleep" level for a specified time. The VSD shall automatically restart when the speed command exceeds the set "wake" level.
19. The sleep mode shall be functional in both follower mode and PID mode.
20. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VSD does not start until dampers or other auxiliary equipment are in the proper state for VSD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VSD to start.
21. The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kW-hr, Output Voltage, DC Bus Voltage, VSD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VSD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.

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22. The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (°F) for a cooling tower application.
23. VSD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
24. If the temperature of the VSD's heat sink rises to 80°C, the VSD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VSD shall automatically reduce its output frequency to the motor. As the VSD's heat sink temperature returns to normal, the VSD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
25. The VSD shall have temperature controlled cooling fans for quiet operation and minimized losses.
26. The VSD shall store in memory the last 10 faults and related operational data.
27. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
28. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VSD status.
29. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
30. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VSD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
31. Under fire mode conditions, the VSD shall be able to be programmed to automatically default to a preset speed.

Q. Adjustments

1. VSD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VSD to the motor.
2. Sixteen preset speeds shall be provided.
3. Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration times shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
4. Four current limit settings shall be provided.
5. If the VSD trips on one of the following conditions, the VSD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.
6. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
7. An automatic "on delay" may be selected from 0 to 120 seconds.

R. Service Conditions

1. Ambient temperature, -10 to 40°C (14 to 104°F).
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 3,300 feet without derating.
4. AC line voltage variation, -10 to +10% of nominal with full output.

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5. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Examination

1. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VSD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
2. The VSD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VSD shall not be operated while the unit is covered.

B. Start-up Service

1. The manufacturer shall provide start-up commissioning of the VSD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VSD, its options and its interface wiring to the building automation system.

- 3.2 CLEANING: After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230514

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SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Available Manufacturers:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Wade
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Available Manufacturers:

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1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Link Seal
 4. Metraflex Company (The).
 5. Pipeline Seal and Insulator, Inc.
 6. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM or Nitrile rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Stainless steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

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3. Using grout, seal the 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 ¼" clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.
- E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated. They are not required at sanitary and storm piping exits unless otherwise indicated.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

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1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 230517

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- B. Terminology as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. Structural Performance: Hangers and supports for HVAC 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 medium.
 - 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.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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PART 2 - PRODUCTS

2.1 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: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
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. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, 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.

- B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8

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	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
	0	0	0	0	0	16	0	16

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:

- a. Anvil International; a subsidiary of Mueller Water Products Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. Haydon Corporation; H-Strut Division.
- e. NIBCO INC.
- f. PHD Manufacturing, Inc.
- g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.

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4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - i. Rooftop Support Systems – Eberl Iron Works, Inc.
 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

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2.5 EQUIPMENT SUPPORTS/RAILS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.
1. Available Manufacturers:
 - a. Curbs Plus, Inc. – CPES-X
 - b. Kees – Equipment Support Model SF
 - c. Pate Company – Equipment Support ES-2
 - d. Portals Plus – ER-2A
 - e. Roof Products and Systems – Equipment Rails ER-2B
 - f. Thybar Corporation – TEMS 3
 2. Construction:
 - a. Minimum 18 gauge, G90 galvanized steel. Fully mitered and welded corners. Integral base plate. 3” Cant style support. All welds prime painted after fabrication. Full-depth internal C-channel reinforcing on 12” centers and 6” spreader channels on alternating 12” centers. 18 Gauge counterflashing factory-installed with tek-screws and neoprene washers. Factory-installed 2’x4” pressure-treated wood nailer.
 - b. Minimum height of 12” above finished roof or as noted.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

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- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. 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 Division 07 Section "Roof Accessories" for curbs.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide 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.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not be used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. 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: Provide 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. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:

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- a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ROOF EQUIPMENT SUPPORTS

- A. Equipment supports must span a minimum of two structural roof members.
- B. No load shall be applied to a cantilever exceeding 12" in length.
- C. Fasten base flange to roof steel or deck with stitch weld or mechanical fastener not exceeding 18" on center in accordance with NRCA specifications.

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. Provide 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.

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3.6 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

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-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".

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8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
 12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
 6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

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K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For steel I-beams. Only allowed for open web joists if load does not exceed 50 lbs.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
16. For sloping structure, provide clamp with swivel such that required threaded rod is vertical. Bending of threaded rod is not acceptable.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

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. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

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3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 230529

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SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development for the State of California.
- D. ASCE: American Society of Civil Engineers

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic design category: D
 - 1. Provide Seismic installation of smoke control systems.
- B. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 120 MPH.
 - 2. Building Classification Category: II.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is perpendicular to the wind direction, and 45 degrees either side of perpendicular.
- C. Component coefficients shall be in accordance with the ASCE 7.

1.4 RESPONSIBILITIES:

- A. The manufacturer of vibration isolation and seismic restraint systems and devices shall:
 - 1. Determine the sizes and locations of isolators and seismic restraints.
 - 2. Provide equipment isolation and seismic restraint indicated.
 - 3. Guarantee indicated isolation system deflections.
 - 4. Provide installation instructions and drawings.
 - 5. Certify correctness of installation upon completion.
- B. The Contractor shall cause all vibration isolation systems, including the isolators, seismic restraints/snubbers and flexible connectors between the isolated equipment and associated piping, ducting, and electrical work to be designed by a manufacturer experienced in this type of work.

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1.5 SUBMITTALS

A. Product Data:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
4. Seismic and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors.

B. Coordination Drawings: For areas indicated at $\frac{1}{4}'' = 1'0''$ and where sections are cut on contract drawings, indicate coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, include other supports and seismic restraints.

C. Qualification Data: For testing agency.

D. Shop Drawings:

1. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
2. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Identify center of gravity.
3. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Locate and describe mounting and anchorage provisions.

E. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

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- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- D. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. B-Line Systems, Inc.
 - 3. Kinetics Noise Control.
 - 4. Mason Industries.
 - 5. Vibration Mountings & Controls, Inc.
 - 6. Vibro-Acoustics, Inc.
- B. Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
 - 2. Durometer Rating: Minimum 30.
 - 3. Number of Layers: 1 2 3 or 4.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Durometer Rating: Minimum 30.
 - 2. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 3. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

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- D. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to ¼" thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to ¼" thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 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.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of ¼" travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

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1. 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.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. 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.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- L. Pipe Riser Resilient Support : All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Include steel and neoprene

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vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- M. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch-thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Available Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Mountings & Controls, Inc.
 - 5. Vibro-Acoustics, Inc.
- B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2" of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

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- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers:

- B. Manufacturers:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.
5. Vibro-Acoustics, Inc.

- C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1" 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 A 36/A 36M. 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.

- D. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) 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 A 36/A 36M. 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.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. Cooper B-Line, Inc.; a division of Cooper Industries.
3. Hilti, Inc.
4. Kinetics Noise Control.

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5. Mason Industries.
 6. Unistrut; Tyco International, Ltd.
 7. Vibro-Acoustics, Inc.
- B. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum ¼" air gap, and minimum ¼" thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Provide for affected systems steel tube, steel slotted-support-system sleeve with internally bolted connections, or reinforcing steel angle clamped to hanger rod.
- G. 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.
- H. 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.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts for nonisolated equipment in up to 10 hp: 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 required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl 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 E 488.

2.5 FACTORY FINISHES

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- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic and wind control devices to indicate capacity range.

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.
- 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. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry seismic loads within loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements indicated in the Contract Documents, in codes and ordinances, by Authority Having Jurisdiction, and by Manufacturer, for installation of all devices.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

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3.5 FIELD QUALITY CONTROL

- A. Perform tests.
- B. Tests:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Prepare test reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 VIBRATION ISOLATION SCHEDULE

- A. Piping and Conduit
 - 1. All piping and conduit connected to pumps, air handling units, or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 20 feet away. Refer to Section "Hydronic Piping" for flexible pipe connectors.
 - 2. Provide spring hangers with 1/2" deflection for suspended piping.
 - 3. Provide spring isolators with 1/2" deflection for floor-mounted piping.
- B. Ductwork

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1. Flexible connectors shall be used for ductwork connections to air handling units. Refer to Section "Metal Duct Accessories." Ductwork shall be suspended with elastomeric hangers for a distance of 20 feet from air handling units.
- C. Packaged Rooftop Units / Rooftop Air Handling Units
1. Provide vibration isolation roof curb rail for rooftop units. Lock out fan and motor assemblies internal isolation provided with rooftop unit. Provide duct connections with flexible duct connectors and pipe connections with flexible piping.
- D. Power Ventilators
1. Provide elastomeric hangers for units suspended from structure above ceiling.
- E. Condensing Units
1. Provide elastomeric neoprene isolator pad with 1/4" deflection located on equipment curb.
- F. Fan-Powered Terminal Units
1. Provide elastomeric hangers for units suspended from structure.

END OF SECTION

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

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- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.

- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

- C. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: White or black.
 - 3. Background Color: Black or white.
 - 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 up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

- D. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White or black.
 - 3. Background Color: Black or white.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

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for greater viewing distances. Include secondary lettering two-thirds to three-quarters 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.

E. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

F. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White or black.

C. Background Color: Black or white.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

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

I. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled. Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or black.
- C. Background Color: Black or white.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 ACOUSTICAL CEILING GRID MARKER

- A. General: Plastic tape a minimum of three one-thousandths of an inch thick (3.0 mils) with pressure-sensitive, permanent-type, self-adhesive back.
- B. Width: three quarters of an inch (3/4") or 22 millimeters.
- C. Letter Size: 1/4" minimum or 8 millimeters.
- D. Letter Color: Black

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- E. Tape Color: White.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION 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.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, omit intermediately spaced labels.

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- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
 - 1. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

- A. Install duct markers with permanent adhesive on air ducts in colors complying with ASME A13.1.
- B. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 FIRE AND SMOKE DAMPERS

- A. Access points for fire, smoke and fire-smoke dampers shall be permanently identified on the exterior of the duct by a label or sign with letters not less than 1" in height reading: "FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER."

3.7 ACOUSTICAL CEILING GRID MARKER INSTALLATION

- A. Attach tape with indicated text to t-bar below item of equipment.
- B. Attach tape to grid.
- C. Prepare surface and attach tape in accordance with manufacturer's recommendations.
- D. Surfaces to receive tape shall be clean and free of scale, dirt, and grease.
- E. Center tape on support grid. Tape shall be visible from within space.
- F. Provide with lettering at equipment located above lay-in tile ceilings including but not limited to:
 - 1. Air Handling Units: Text = AHU
 - 2. Terminal Units (VAV boxes): Text = TU
 - 3. Coils: Text = C
 - 4. Heat Pumps: Text = HP
 - 5. Cabinet Unit Heaters: Text = CUH

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6. Fans: Text = F
7. Damper operators: Text = D

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 230553

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SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Outdoor duct and pipe: Duct conveying untreated outside air at ambient temperature and humidity.
- B. Outdoor pipe: Pipe located outside the building insulation envelope.
- C. Supply air duct: Duct conveying air on the discharge side of an air handling unit or fan which will be delivered to a space in a building through a diffuser or connection to the return duct of another unit. Ductwork on the discharge side of a 100% outside air unit is considered to be Supply air duct.
- D. Return air duct: Duct conveying air from a space or plenum that will return to an air handling unit or energy transfer device. The air may be returned to the supply air duct after being conditioned, or it may be exhausted after passing through an energy transfer device. Typical examples of an energy transfer devices are plate heat exchangers, runaround coils, heat pipes, and energy wheels.
- E. Exhaust air duct: Duct conveying air from a space or plenum that will be exhausted from the building without being passed through an energy transfer device.
- F. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- G. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- H. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 3. Detail attachment and covering of heat tracing inside insulation.

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4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation, duct Installer for duct insulation, and equipment Installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
 1. Mineral-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.

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2. Flexible Elastomeric Thermal Insulation:
 - a. Aeroflex USA, Inc.
 - b. Armacell, LLC.
 - c. K-Flex USA.
 - d. Rubatex Corp.
 3. Grease (Kitchen Hood) Exhaust Duct
 - a. 3M
 - b. Morgan Thermal Ceramics
 - c. Unifrax
- B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Duct Liner: Refer to specification section "Metal Ducts"
- H. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F.. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- I. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- J. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:
1. Thickness: 1-1/2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 5.1
 - c. Minimum installed R value assuming 25% compression: 4.2
 2. Thickness: 2"
 - a. Density: 1.0 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0

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3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
4. Thickness: 3"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 10.2
 - c. Minimum installed R value assuming 25% compression: 8.3
- K. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- L. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- M. Grease (Kitchen Hood) Exhaust
 1. 2-Hour applied fire resistance rating for grease duct applications when tested in accordance with ASTM E 2336.
 2. Compliant per UL Listing HNK T G14 (Single Layer Installation).
 3. 2 Hour F- and T-Rated Through Penetration Firestop when tested in accordance with ASTM E 814 (UL 1479).
 - a. Thermal Material shall be 2000 F degree rated blanket with all service jacket manufactured from fiberglass reinforced aluminum or polypropylene scrim.
 - b. Jacket shall be marked with UL Classification.
 - 1) Thickness shall be 4 inches maximum.
 - 2) Nominal density shall be 6 pounds per cubic foot.
 - 3) R-value shall be 7.0 minimum when tested in accordance with ASTM C 518.
- N. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

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6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- O. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- P. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- 2.2 FIELD-APPLIED JACKETS
- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.
- C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
 2. PVC Duct Jacket Color: White or gray.
 3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
 3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.
- G. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

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- H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.3 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.
- B. For chilled water pumps, provide min 22-gauge stainless steel box around suction diffuser and pump housing with 2" thick close cell elastomeric insulation liner adhered to inside of box. The box shall be designed to be in two (2) halves with latching clips/ latches for easy removal and re-installation. Where the two halves come together, there should be gasketing material for tight seal and along base. Alternative acceptable approaches are the use of pump insulation covers manufactured by Fit Tight Covers design for removable pump insulation covers.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

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2.5 VAPOR RETARDERS

- A. Mastics: Materials that are compatible with insulation materials, jackets, and substrates.

2.6 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- 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 APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts, piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair, shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

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- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges, pipe joints, and fittings.
- O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- P. Install vapor-retarder mastic on ducts, pipes, plenums, and equipment.
 - 1. Ducts, pipes, plenums, and equipment with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape and mastic to maintain vapor-retarder seal.
 - 2. Ducts, pipes, plenums, and equipment without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

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1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts, Pipes, and Plenums: Secure blanket insulation with adhesive, and anchor pins with speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, pipe, and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts & pipes and to all surfaces of fittings and transitions. Adhesive may be omitted from the top of horizontal rectangular ducts.
 3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, 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 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.
 4. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 5. Impale insulation over anchors and attach speed washers.
 6. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 7. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 8. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 9. Apply insulation on rectangular duct elbows, pipe fittings, and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows, and pipe elbows, with individually mitered gores cut to fit the elbow.
 10. Insulate duct and pipe stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts, Plenums, & Equipment: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings, transitions, and equipment. Adhesive may be omitted from top surface of horizontal rectangular ducts.
 3. Space anchor pins as follows:

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- a. On duct & equipment sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct & equipment sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.
4. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 5. 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 segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct and equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating materia. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts, plenums, and equipment as follows:
 1. Follow the manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply 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 jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.7 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Paints."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

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

3.8 DIFFUSER APPLICATIONS

- A. Insulate exposed metal surfaces on top of all supply diffusers. Where diffusers are mounted in a metal pan insulate the top of the metal pan.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 - 2. Thickness: 1 inch.
 - 3. Vapor Retarder Required: Yes.

3.9 GREASE DUCT INSULATION APPLICATION

- A. Apply insulation to grease ducts as follows:
 - 1. Follow the manufacturer's written instructions for applying insulation to meet ASTM E 2336 and the listing.
 - 2. Apply insulation from duct point of origin (hood connection) to discharge (outdoor). Where passing through rated walls or floors, provide fire stop assembly per the listing.

3.10 APPLICATIONS

- A. Insulation materials and thickness are specified at the end of this Section.
- B. Insulate all ductwork, pipe and equipment:
 - 1. Insulate ductwork in accordance with the application schedule(s) below.
 - 2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic condensate drain piping.
 - h. Pipe-mounted condensate sensors.
 - i. Return ductwork inside the building insulation envelope.
 - j. Indoor exposed return air ductwork.
 - k. Exhaust ductwork.
 - 1) Exception: Duct beginning 18" upstream of backdraft damper and continuing to building envelope insulation.
 - l. Metal ducts with duct liner.
 - m. Factory-insulated flexible ducts.
 - n. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - o. Flexible connectors.
 - p. Access panels and doors in air-distribution systems.

3.11 INDOOR APPLICATION SCHEDULE

- A. Service: Grease (Kitchen Hood) Exhaust

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1. Insulation Material: Grease (Kitchen Hood) Exhaust Insulation
 2. Insulation Thickness: 4" maximum
 3. Vapor Retarder Required: No.
 4. Finish: none.
- B. Service: Condensate drain piping except plastic.
1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Finished Spaces = Painted, concealed = none.
- C. Refrigerant Suction and Hot-Gas Piping/Tubing:
1. Insulation Material and Thickness:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Service: Unless otherwise indicated provide the following:
1. Concealed Ducts and Plenums:
 - a. Material: Mineral-Fiber Blanket.
 - b. Thickness: 2 inches.
 - c. Vapor Retarder Required: Yes.
 2. Ducts and Plenums in Finished Spaces:
 - a. Material: Mineral-Fiber Board.
 - b. Thickness: 1-1/2 inches.
 - c. Field-Applied Jacket: Glass cloth.
 - d. Vapor Retarder Required: Yes.
 - e. Paint: Color as selected by architect. Refer to section "Painting".
- E. Service: Round and flat oval, supply-air ducts, concealed and within the building insulation envelope.
1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.
 3. Vapor Retarder Required: Yes.
- F. Service: Round and flat oval, outside-air ducts, concealed and within the building insulation envelope.
1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.
 3. Vapor Retarder Required: Yes.
- G. Service: Rectangular, supply-air ducts, concealed and within the building insulation envelope.
1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.
 3. Vapor Retarder Required: Yes.
- H. Service: Rectangular, outside-air ducts, concealed and within the building insulation envelope.
1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.

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3. Vapor Retarder Required: Yes.
- I. Service: Round and flat oval, supply-air ducts, concealed in vented attics and in unvented attics with insulated ceilings.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 2 inches.
 3. Vapor Retarder Required: Yes.
- J. Service: Round and flat oval, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.
 3. Vapor Retarder Required: Yes.
- K. Service: Rectangular, supply-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 2 inches.
 3. Vapor Retarder Required: Yes.
- L. Service: Rectangular, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.
 3. Vapor Retarder Required: Yes.
- M. Service: Round and flat oval, supply-air ducts, exposed.
 1. Refer to section "Metal Ducts"
- N. Service: Round and flat oval, outside-air ducts, exposed.
 1. Refer to section "Metal Ducts"
- O. Service: Rectangular, supply-air ducts, in Finished Spaces.
 1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
 2. Thickness: 1-1/2 inches.
 3. Field-Applied Jacket: Glass cloth.
 4. Vapor Retarder Required: Yes.
 5. Paint: Color as selected by architect. Refer to section "Painting".
- P. Service: Rectangular, outside-air ducts, in Finished Spaces.
 1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
 2. Thickness: 2 inches
 3. Field-Applied Jacket: Glass cloth.
 4. Vapor Retarder Required: Yes.
 5. Paint: Color as selected by architect. Refer to section "Painting".
- Q. Service: Range-hood exhaust ducts, concealed and in Finished Spaces.
 1. Range hood exhaust ducts shall be listed, labeled, factory-built, and insulated commercial kitchen grease ducts as specified in section "Metal Ducts".

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3.12 OUTDOOR APPLICATION SCHEDULE

- A. Insulation shall be applied after heat tracing and temperature sensors are in place and have been tested.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. Insulation Material and Thickness:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - 2. Finish: Two coats of UV coating or mastic protectant recommended by the insulation manufacturer or outdoor aluminum jacket.
- C. Service: Round, supply-air ducts.
 - 1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in section "Metal Ducts".
- D. Service: Round, return-air ducts.
 - 1. Material: Round supply air ducts shall be factory fabricated double wall ducts as specified in section "Metal Ducts".
- E. Service: Rectangular, supply-air ducts.
 - 1. Material: Mineral-fiber board.
 - 2. Total Thickness: 2 Inches (two 1" layers).
 - 3. Number of Layers: Two
 - 4. Field-Applied Jacket: Glass cloth.
 - 5. Vapor Retarder Required: Yes
 - 6. Outer Jacket: Corrugated Aluminum.
 - a. Thickness: Minimum 0.024 inches.
- F. Service: Rectangular, return-air ducts.
 - 1. Material: Mineral-fiber board.
 - 2. Total Thickness: 2 Inches (two 1" layers).
 - 3. Number of Layers: Two
 - 4. Field-Applied Jacket: Glass cloth.
 - 5. Vapor Retarder Required: Yes
 - 6. Outer Jacket: Corrugated Aluminum.
 - a. Thickness: Minimum 0.024 inches.

END OF SECTION 230700

SECTION 230800 – COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 220800 – Commissioning of Plumbing Systems
- D. Section 250800 – Commissioning of Integrated Automation Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. The purpose of this section is to specify commissioning responsibilities directly related to the Division 23 contractors and vendors. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein.
- B. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Mechanical Contractors alone.
- C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Mechanical Systems, which are a part of this project.
- D. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.

- E. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The mechanical trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, mechanical, vendors, manufacturers and chemical treatment. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.
- F. Mechanical Contractor(s) are responsible for mechanical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 23 specification sections. Mechanical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- G. Sections 019113 - Commissioning General Requirements and 230800 – Commissioning of Mechanical Systems DO NOT relieve the Mechanical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 230800 – Commissioning of Mechanical Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

1.3 DEFINITIONS

- A. Mechanical Contractor(s): The term Mechanical Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 23 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 23 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing test, adjustment and balance or a company performing cleaning, flushing and water treatment tests for hydronic systems.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

1.4 ROLES AND RESPONSIBILITIES

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vender or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 23 of the specifications and project drawings.
- B. Every Mechanical Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 23 Contractors are responsible for the requirements defined in specification 019113 section 1.4 subsections for their particular role:
- D. Mechanical Contractor(s)
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Controls Contractor(s)
1. Controls Contractors may be a subcontractor to the Mechanical Contractor but their responsibilities are defined in specification 250800 – Commissioning of Integrated Automation Systems. Controls Contractors installing controls under Division 23 shall follow the requirements set forth in specification 250800 – Commissioning of Integrated Automation System but will apply the same requirements to the Division 23 installations for which they are responsible.
- F. Test, Adjustment and Balance Contractor(s)
1. The Test, Adjustment and Balance (TAB) Contractor is a Third Party Test Agency and therefore their roles and responsibilities are defined in section H below.

2. The TAB Contractor contributes a very large part to the Commissioning Process:
 - a. TAB is required to provide early submittals, installation inspections, etc.
 - b. TAB has several various report types which are all included within Quality Control requirements.
 - c. TAB Verification is accomplished by TAB performing a large portion of the Pre-Verification Tests and repeating these measurements as Functional Performance Tests witnessed by the Commissioning Agent. In the case of TAB Verification, the TAB contractor must account for performing TAB once for their Final TAB Report and a spot-check of readings to be performed during Functional Performance Testing. See 019113 section 3.10-H for details regarding redundant equipment spot-checks.

- G. Equipment Manufacturer(s)
 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

- H. Third Party Testing Agencies
 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

1.5 SYSTEMS INCLUDED IN COMMISSIONING

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 23 Mechanical Systems included within the Commissioning Scope.

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
1. Quality Control Plans and Tests
 2. Electrical Energization
 3. Equipment and Systems Start-Up
 4. Pre-Functional Checklist Completion
 5. Third Party Testing
 6. Pre-Verification Testing
 7. Functional Performance Testing
 8. Training and Orientation
 9. Close-Out Document Review (O&M's, As-Built, Warranties)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Work products to be provided by the Mechanical Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Mechanical Contractors, Manufacturers and Third Party Test Agencies Include:
1. 2.1 - Project Schedule
 2. 2.2 - Submittals
 3. 2.3 - Quality Control Plan
 4. 2.4 - Quality Control Reports
 5. 2.5 - Pre-Functional Checklists
 6. 2.7 - Systems and Equipment Start-Up Plan
 7. 2.9 - Systems and Equipment Start-Up Reports
 8. 2.10 - Pre-Verification Tests
 9. 2.11 - Functional Performance Tests
 10. 2.12 - Systems and Equipment Training Plan
 11. 2.13 - Test and Proprietary Equipment
- B. Work products under the Construction Manger/General Contractor purview are to be coordinated with the Mechanical Contractors, Manufacturers and Third Party Test Agencies to ensure products are up to date and accurate.
- C. Work products under the Contractors purview outside of Division 23 are to be coordinated with the Mechanical Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 23 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 23 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

PART 3 - EXECUTION

3.1 GENERAL

- A. Execution of Commissioning Activities to be performed by the Mechanical Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Mechanical Contractors, Manufacturers and Third Party Test Agencies Include:

1. 3.1 – Commissioning Plan and Kick-Off Meeting
2. 3.2 – Construction Observations
3. 3.5 – Systems and Equipment Start-Up
4. 3.6 – Temporary Utilization
5. 3.7 – Quality Control and Start-Up Reporting
6. 3.8 – Pre-Functional Checklists
 - a. Mechanical PFC's are primarily the responsibility of the Mechanical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to complete portions of the Mechanical PFC's. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
 - b. Mechanical Contractors are responsible for portions of PFC's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
7. 3.9 – Pre-Verification Tests
 - a. Mechanical PVT's are primarily the responsibility of the Mechanical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Mechanical PVT's. For these activities, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
 - b. Mechanical Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
8. 3.10 – Functional Performance Tests
 - a. Mechanical FPT's are primarily the responsibility of the Mechanical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Mechanical FPT's. For these activities, the Mechanical

Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.

- b. Mechanical Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.

9. 3.11 – TAB Verification

- a. Test, Adjustment and Balance is generally considered a Mechanical Trade and performed under Division 23.

10. 3.12 – Integrated Systems Test

11. 3.13 – Operations and Maintenance Manuals

12. 3.14 – Systems and Equipment Training

13. 3.15 – Exclusions

14. 3.16 – Prerequisites to Substantial Completion

- B. Execution of Commissioning Activities under the Construction Manger/General Contractor purview are to be coordinated with the Mechanical Contractors, Manufacturers and Third Party Test Agencies to ensure activities are executed without any impedance or interference by Division 23 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 23 are to be coordinated with the Mechanical Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 23 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 23 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

3.2 SCHEDULE

- A. The Mechanical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Mechanical Systems such that all deficiencies are resolved prior to Final Acceptance.

3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES

- A. The Mechanical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Mechanical Contractor(s). Mechanical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Mechanical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.4 DEFICIENCIES AND FAILURES

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.

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- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. This is referred to below as the Percent Failure Time. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. The percent of the failure time out of the total test time is calculated as follows:
1. Total Time = The total time the team is present to witness the entire test activity (including down time.)
 2. Down Time = Time spent by the Commissioning Team while waiting for reparations or waiting on any contractor to arrive or prepare their activities.
 3. Test Time = The time the test should take if execution goes correctly without delays or deficiencies.
 4. Test Time = Total Time – Down Time
 5. Percent Failure Time = Down Time / Test Time
 6. Example 1: Commissioning Team is on site for an 8 hour day but only 4 hours are effectively witnessing test activities due to a few delays: waiting for the test equipment to arrive, system adjustments are made during testing, etc. Test Time = 4. Down Time = 4. Failure Percent Time = $4 / 4 = 100\%$. Ultimately, the Commissioning Team doubled the time that should have been spent witnessing this small test. The Commissioning Agent may request reimbursement for the additional 4 hours spent on site.
 7. Example 2: Commissioning Team is on site for an 8 hour day and 7 hours and thirty five minutes are effectively witnessing test activities due to only minor system adjustments. Test Time = 7.6. Down Time = 0.4. Failure Percent Time = $0.4 / 7.6 = 5\%$. Ultimately, the Commissioning Team spent a whole day on site which would have been needed regardless of the minor adjustments. The Commissioning Agent would not request reimbursement for the additional 25 minutes spent on site. This is considered reasonable.
- F. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.

- G. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- H. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

3.5 DEFICIENCY RESOLUTION

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.6 ADDITIONAL COMMISSIONING

- A. The Mechanical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, additional inspections due to false PFC's, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at a rate of \$152/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager/General Contractor's Application for Payment. The Construction Manager/General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

3.7 SEASONAL COMMISSIONING

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

END OF SECTION 230800

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SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Scope of Work:

1. Furnish a totally native BACnet-based system, including a Microsoft Vista compatible operator's workstation. The operator's workstation, building controllers, application controllers, and input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2008, BACnet. In other words, workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
2. Provide necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
3. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
4. Implement the detailed design for analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
5. Design, provide, and install equipment cabinets, panels, data communication network cables needed, and associated hardware.
6. Provide and install interconnecting cables between supplied cabinets, application controllers, and input/output devices.
7. Provide and install interconnecting cables between operator's terminals and peripheral devices supplied under this section.
8. Provide complete manufacturer's specifications for items that are supplied. Include vendor name of every item supplied.
9. Provide supervisory specialists and technicians at the job site to assist in phases of system installation, startup, and commissioning.
10. Provide comprehensive operator and technician training program as described herein.
11. Provide as-built documentation, operator's terminal software, diagrams, and other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
12. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

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B. Related Sections include the following:

1. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.
2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

C. Work Under Other Sections:

1. All wells, valves, taps, dampers, flow stations, etc. furnished by the BAS manufacturer shall be installed under Section "Hydronic Piping".
2. The following shall be provided under Division 23 specifications sections:
 - a. 120V power to BAS panels and devices with circuits indicated on the drawings. See paragraph "Coordination" below.
 - b. Wiring of power feeds to disconnect switches and starters.
 - c. Wiring from disconnect switches and starters to electric motors.
 - d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished under this section of the specifications.

1.3 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2008, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control mechanical equipment, including but not limited to unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. Operator's workstation software shall use Microsoft Windows 10 as the computer operating system. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. Software required to program application specific controllers and field level devices and controllers will be left with the owner. Software passwords required to program and make future changes to the system will also become the property of the owner. Software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. Software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. Software required for field engineering tools including graphical programming and applications will be left with the owner. Software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.

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- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. Energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- D. Room sensors shall be architecturally pleasing, sense temperature, allow tenant to override system and adjust temperature setpoint, and include a jack that allows the service technician to adjust any zone parameter. Include wiring for sensor and field service tool.
- E. Application controllers for every terminal unit (including but not limited to VAV) air handler, central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - k. Airflow (Terminal): Plus or minus 10 percent of full scale.

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- l. Air Pressure (Space): Plus or minus 0.01-inch wg.
- m. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
- n. Carbon Dioxide: Plus or minus 50 ppm.
- o. Electrical: Plus or minus 5 percent of reading.

1.5 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Substantial Completion.
- B. Services, materials, and equipment shall include but not be limited to:
 - 1. The adjustment, required testing, and repair of the system including all computer equipment, transmission lines, transmission equipment, sensors and control devices.
 - 2. On-line support services shall be provided as follows:
 - a. The local BAS representative shall have the capability to monitor and control the facility's building automation system via a dialup or internet connection. This connection to the facility shall be made within 2 hours of the time a problem is reported.
 - b. If the problem is not resolved by local support, the national office of the building automation system manufacturer, having the same dialup capability, shall also attempt to solve the problem online. If the problem cannot be resolved with on-line support, the BAS representative shall dispatch the appropriate personnel to the job site to resolve the problem within 4 hours of the time that the problem is reported.
 - c. This coverage shall include normal business hours, after business hours, weekends and holidays.

1.6 SUBMITTALS

- A. Pre-submittal meeting: The Contractor performing work under this Section of the specifications shall attend a meeting for coordinating the control system with major pieces of equipment including Rooftop Units, Chillers and Boilers. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the Contractor. The Contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Submit ten (10) complete sets of documentation in the following phased delivery schedule:
 - 1. Schedule of dampers including size, leakage, and flow characteristics.
 - 2. Schedule of valves including leakage and flow characteristics.
 - 3. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Include each control device labeled with setting or adjustable range of control.

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- a. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - b. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - c. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
4. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include the following:
- a. System schematics, including:
 - 1) Written sequences of operation
 - 2) Listing of connected data points, including connected control unit and input device.
 - a) Point names
 - b) Point addresses
 - 3) Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4) Details of control panel faces, including controls, instruments, and labeling.
 - 5) Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 6) Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 7) System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 8) System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
1. Maintenance instructions and lists of spare parts for each type of control device.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.
- D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

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- E. Upon project completion, submit operation and maintenance manuals, consisting of the following:
1. Index sheet listing contents in alphabetical order.
 2. Manufacturer's equipment parts list of all functional components of the system.
 3. DVD of system schematics including wiring diagrams.
 4. Sequences of operations
 5. As-built interconnection wiring diagrams.
 6. Operator's manual.
 7. Trunk cable schematic showing remote electronic panel locations and all trunk data.
 8. List of connected data points, including panels to which they are connected and input device (sensors, thermostat, etc.)
 9. Software and firmware operational documentation. Include the following:
 - a. Software operating and upgrade manuals.
 - b. Program software backup: On a magnetic media or compact disc, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.
 - e. Software license required by and installed for DDC workstations and control systems.
 10. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.
 11. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system. Submit a schedule of airflow measuring devices indicating compliance with specified accuracy at minimum and maximum airflow rates. Submit installation, operation and maintenance documentation.

1.7 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned, and serviced by a manufacturer's authorized installer.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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- E. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, governing radio frequency electromagnetic interference and shall be so labeled.
- F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- G. Comply with ASHRAE 135 for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

- A. Control Wiring: The BAS manufacturer shall be responsible for all BAS and temperature control wiring for a complete and operable system. All wire and cable shall be plenum-rated and shall be in accordance with Division 26 specification sections and all local, state and national codes and ordinances.
- B. Where plenum-rated BAS cable is routed in concealed, accessible spaces, the cable may be run in the cable trays or in J-Hooks provided under this section of the specifications. Where plenum-rated BAS cable is routed in exposed or inaccessible areas, it shall be run conduit provided under this section of the specifications.
- C. Power Wiring:
 - 1. Power wiring indicated (device and circuit designation indicated) on the drawings shall be provided under Division 26.
 - 2. The BAS manufacturer shall be responsible for power wiring not indicated (device or circuit designation not indicated) on the Drawings. It shall be the BAS manufacturer's responsibility to review the Contract Documents to determine the extent of power wiring included in Division 26 and to provide additional power wiring as required. Work shall be in accordance with Division 26 specifications and all local, state and national codes and ordinances.
 - 3. Where the contractor performing work under this section requires an additional circuit for power wiring to a device or panel under paragraph 2 above, an RFI shall be issued requesting approval to use an available circuit in the nearest panel. Once approval is granted, all wiring and conduit from the breaker to the device or panel shall be provided under this section of the specifications.
- D. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. All conduits shall be concealed within walls and above ceilings unless indicated otherwise.
- E. FACILITY SPECIFIC REQUIREMENTS

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1. In areas accessible to inmates (such as housing or dayrooms) temperature and humidity sensors shall be installed in the return/exhaust air ductwork or rooftop unit return/exhaust and not in a location accessible to inmates.
 - F. Coordinate installation of conduit to avoid cutting of finished surfaces.
 - G. Coordinate equipment with Division 26 Section "Lighting Control Devices" to achieve compatibility with equipment that interfaces with that system.
 - H. Coordinate equipment with Division 28 Section "Digital Addressable Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
 - I. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- 1.10 PROJECT CONDITIONS
- A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1 MANUFACTURER

1. Delta Controls
2. Johnson Controls
3. Schneider Electric

2.2 OPERATOR'S WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 simultaneous clients.
- B. BACnet Conformance:
 1. Operator Work Station shall be approved by the BTL as meeting the BACnet Advanced Work Station requirements.
 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that shall be directly supported to provide each of the functional groups listed above. Proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output,

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Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.

4. The operator's workstation shall comply with Annex J of the BACnet specification for IP connections. Shall support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Shall support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. Displays:

1. Operator's workstation shall display data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. Information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules and other functions, from any screen, no matter if that screen shows text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
2. Displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text such as Hand-Off-Auto. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse, for example, a graphic of a switch or light, which then displays a different graphic (such as an "ON" switch or lighted lamp. Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or

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creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trend logs.
5. Analog objects may also be assigned to a system graphic, where the color of the defined object changes based on the analog object's value. For example, graphical thermostat device served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. Editing and area assignment shall be created or modified online using simple icon tools.
6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
7. The BAS displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.
8. The BAS system shall have the ability to run multiple, concurrent displays windows showing continuously updated data.
9. Summary graphics shall be provided for groups of equipment such as, but not limited to, air handling units and VAV terminal units.
10. Coordinate graphics with the commissioning authority.

D. Password Protection:

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. Each operator's terminal shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to discrete BACnet devices to which that user requires access. Passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Users shall have the capability to be assigned to specific user type "groups" that can share the same access

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levels to speed setup. Users who are members of multiple "groups" shall have the ability to activate/deactivate membership to those groups while using BAS (without logout). Users shall also have a set security level, which defines access to displays and individual objects user may control. System shall include 10 separate and distinct security levels for assignment to users.

3. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
4. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. Operator Activity Log that tracks operator changes and activities shall be included with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.
2. Log shall be gathered and archived to hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Any displayed data that is changeable by the operator may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show operator changes of just that displayed data.

F. Scheduling:

1. Operator's workstation shall show information in easy-to-read daily format including calendar of this month and next. Schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each individual zone shall have optimum start time independently calculated based on parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the

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schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

G. Alarm Indication and Handling:

1. Operator's workstation shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the applications currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).
4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
5. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or launch the Alarm Wizard to allow the creation of a new alarm.

H. Trendlog Information:

1. System server shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the operator's workstation. Operator shall be able to view trended records, both stored and archived. Trendlog records shall be displayed in standard engineering units.
2. Software that is capable of graphing the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 10 object types at the same time in different colors. Graphs shall show object values relative to time. Each trendlog shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. Operator shall be able to change Trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. Input, output, and value object types in the system may be logged. Operations shall be password protected. Setup and viewing may be accessed directly from any and graphics on which object is displayed.
4. System shall include a Trend Wizard for setup of logs. Wizard shall walk user through necessary steps. Wizard shall have its own pull-down selection for startup, or may be

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started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

5. System shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog view or launch the Trendlog wizard to allow the creation of a new trend.

I. Energy Log Information:

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display energy log information in standard engineering units.
2. Data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during graphing operations.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. Meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, user shall be able to select a specific period of data to view.

J. Reports:

1. System server shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
2. Reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

K. Configuration/Setup: Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

L. Field Engineering Tools:

1. Operator's workstation software shall include field engineering tools for programming controllers supplied. Controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.

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3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. System shall automatically notify the user when a device that is not in the database is added to the network.
7. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
8. The system shall provide a means to scan, detect, interrogate, and edit 3rd party BACnet devices and BACnet objects within those devices.

M. Workstation Hardware:

1. Provide operator's workstations at locations noted on the plans.
2. Workstation/server computer minimum requirements
 - a. PC Processor of 2 GHz dual-core or better.
 - b. 8 GB RAM or better.
 - c. 500GB hard disk or better.
 - d. High-performance graphics adapter.
 - e. Ethernet 10/100 network interface card.
 - f. Keyboard, monitor, mouse, USB port and CD-ROM.
 - g. Windows 10.
 - h. Modem, 56Kbm Minimum.
 - i. Color printer (inkjet, color dye or laser).

- N. Software: At the conclusion of project, contractor shall leave with owner a CD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, and other components. This backup shall allow the owner how to completely restore the system in the case of a computer malfunction.

2.3 WEB INTERFACE

- A. General: BAS supplier shall provide Web-based access to the system as part of standard installation. User shall be able to access displays of real-time data that are part of the BAS using a standard Web browser. Web browser shall tie into the network through owner-supplied Ethernet network connection. Web page host shall be a separate device that resides on the BAS BACnet network, but is not the BAS server for the control system. BAS server shall be a

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separate computer from the Web page host device to ensure data and system integrity. The Web page software shall not require a per-user licensing fee or annual fees. The Web page host shall be able to support on average 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.

- B. **Browser Technology:** Browser shall be standard version of Microsoft Internet Explorer v6.0 or later, Firefox v2.0 or later and Safari v2.0 or later (on Mac OS X). PDA browser connection shall be Pocket PC 2003, Windows Mobile 5.0, or Blackberry. No special vendor-supplied software shall be needed on computers running browser. Displays shall be viewable and the Web page host shall directly access real-time data from the BAS BACnet network. Data shall be displayed in real-time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate user name and password.
- C. **Communications:**
1. Web page host shall include two Ethernet network connections. One network connection shall be dedicated to BAS BACnet network and shall be used to gather real-time data from the BACnet devices that form the BAS. This network shall communicate using BACnet, allowing the Web page host to gather data directly from units on the local LAN or from other projects connected over a WAN. This network shall also provide the connection to the BAS server for Web page generation.
 2. The second Ethernet connection shall provide the physical connection to the Internet or an IP-based WAN. It shall be the port that is used for the browser to receive Web pages and data from the Web page host. The Web page host shall act as a physical barrier between BAS network and the WAN or Internet connection that allows browser to receive Web pages and data. The two separate network connections provide for a physical barrier to prevent raw BACnet traffic being exposed on IP network.
 3. The Web page host shall provide for complete isolation of the IP and BACnet networks by not routing networking packets between the two networks.
 4. BAS BACnet Ethernet network shall be provided and installed by the BAS supplier. Owner shall provide and incur any monthly charges of WAN/Internet connection.
- D. **Display of Data:**
1. Web page graphics shown on browser shall be replicas of the BAS displays. User shall need no additional training to understand information presented on Web pages when compared to what is shown on BAS displays. Web page displays shall include animation just as BAS displays. Fans shall turn, pilot lights shall blink, coils shall change colors, and so on.
 2. Real-time data shall be shown on browser Web pages. This data shall be directly gathered using the BACnet network and automatically updated on browser Web page displays without any user action. Data on the browser shall automatically refresh as changes are detected without re-drawing the complete display.
 3. It shall be possible for user from browser Web page to change data if the user is logged on with the appropriate password. Clicking on a button or typing in a new value shall change digital data. Using pull-down menus or typing in a new value shall change analog data.
 4. Data displays shall be navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.

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E. Time Schedule Adjustment:

1. Web access shall allow user to view and edit schedules in the system. This includes standard, holiday and event schedules as described in BAS specification. Display of schedules shall show interaction of schedules on a single display so user sees an overview of how work together. User shall be able to edit schedules from this display.
2. Display of three schedules shall show ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each shall also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show points and zones affected. User shall be able to set time for one day and select days of the week that shall be affected as a recurrence of that same schedule for that given day.
3. Schedule list shall show schedules currently defined. This list shall include standard, holiday and event schedules. In addition, user shall be able to select a list that shows scheduled points and zones.

F. Logging of Information: User shall use standard browser technology to view trendlogs in system. User shall be able to view logged data in tabular form or graphical format. User shall be able to adjust time interval of logged data viewed and shall be able to adjust Y axis of data viewed in graphical format. User shall also be able to download data through the Web interface to local computer. Data shall be in CSV format.

G. Alarm Handling: Web interface shall display alarms as they occur. User shall be able to acknowledge alarms using browser technology. In addition, user shall be able to view history of alarm occurrence over a user-selected time frame. In addition, those alarms may be filtered for viewing per user-selected options. A single selection shall display alarms that have not been acknowledged.

H. Web Page Generation: Web pages shall be automatically generated from the BAS displays that reside on the BAS server. User shall access Web page host through the network and shall initiate a Web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access using any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages shall not be considered.

I. Password Security and Activity Log: Access through Web browser shall utilize the same hierarchical security scheme as BAS system. User shall be asked to log on once the browser makes connection to Web page host. Once the user logs in, any and changes that are made shall be tracked by the BAS system. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and activity of the users who have logged in to the system, regardless of whether those changes were made using a browser or through the BAS workstation.

J. BACnet Communication: Web server shall directly communicate to devices on BAS network using BACnet protocol. No intermediate devices is necessary for BACnet communication.

2.4 BUILDING CONTROLLER

A. General Requirements:

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1. BACnet Conformance:
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in BACnet standard, for a complete list of the services that shall be directly supported to provide each of the functional groups listed above. Proprietary services, if used in the system, shall be thoroughly documented and provided as part of submittal data. Necessary tools shall be supplied for working with proprietary information.
2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, Ethernet communications and controllers-including central plant controllers, advanced application controllers and unitary controllers-supplied by BAS manufacturer shall utilize the BACnet protocol standard.
3. Modules shall be selected to fit the particular project application. Up to seven modules powered by a single power supply module. Modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. Module in middle shall be replaceable without removing any other modules.
4. Modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. Software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. Flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for controllers.
6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
8. Global control algorithms and automated control functions shall execute using 32-bit processor.

B. Schedules:

1. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
2. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.

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3. Logging Capabilities:

- a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
- b. Logs may be viewed both on-site or off-site using WAN or remote communication.
- c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
- d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

C. Alarm Generation:

1. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Each alarm may be dialed out as noted elsewhere.
3. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
4. Controller shall be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

D. Ethernet - MS/TP Module:

1. Ethernet - MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
2. Communication with operator's workstation and application controllers shall be through BACnet. Building controller Ethernet - MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP LAN. Ethernet - MS/TP module shall also route messages from other building controller modules onto the BACnet Ethernet network.
 - a. MS/TP LAN shall be software-configurable from 9.6 to 76.8Kbps.
 - b. The RJ-45 Ethernet connection shall accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

3. BACnet Conformance:

- a. Ethernet - MS/TP module shall, as a minimum, support MS/TP and Ethernet BACnet LAN types. It shall communicate directly using these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between supported LAN types. Global controller shall be approved by the BACnet Testing Laboratory (BTL) as meeting the BACnet Building Controller requirements.
- b. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
- c. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork,

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while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Shall support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).

E. MS/TP Module:

1. MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
2. Building controller MS/TP module communications shall be through BACnet MS/TP LAN to advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN.
 - a. MS/TP LAN shall be software configurable from 9.6 to 76.8Kbps
 - b. Configuration shall be through RS-232 connection.
3. BACnet Conformance:
 - a. MS/TP module shall be approved by the BTL (BACnet Testing Laboratory) as meeting the BACnet Building Controller requirements. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly using this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between supported LAN types.
 - b. Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.

F. Power Supply Module:

1. Power supply module shall power up to seven building controller modules. Input for power shall accept between 17-30VAC, 47-65Hz.
2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of data in flash memory and for continuous operation of real-time clocks for minimum of 20 days.

2.5 CENTRAL PLANT AND AIR HANDLER APPLICATION CONTROLLERS

- A. Provide one or more native BACnet application controllers for each air handler and provide native BACnet application controllers as needed for central plant control that adequately cover objects listed in object list. Controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.
- B. BACnet Conformance:

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1. Application controllers shall be approved by the BTL as meeting the BACnet Advanced Application Controller requirements.
 2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that shall be directly supported to provide each of the functional groups listed above. Proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0-10VDC, Platinum 1000 ohm RTD, 0-5VDC, 4-20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 12-bit resolution shall support either 0-10VDC or 0-20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.
1. Outputs shall have onboard Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
 2. The position of each HOA switch shall be available system wide as a BACnet object property.
- D. Program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. Program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math and system shall support display of information in floating-point nomenclature at operator's terminal.
1. The following control blocks shall be supported:
 - a. Natural Log.
 - b. Exponential.
 - c. Log base 10.
 - d. X to the power of Y.
 - e. Nth square root of X.
 - f. 5th Order Polynomial Equations.
 - g. Astronomical Clock (sunrise/sunset calculation).
 - h. Time based schedules.
- E. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by

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graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.

- F. Application controller shall include support for intelligent room sensor. Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. Button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- G. Schedules: The controller shall support a minimum of 3 BACnet Schedule Objects and have a real time clock on board with battery backup to maintain time through a power loss.
- H. Logging Capabilities:
 - 1. Controller shall support a minimum of 50 trendlogs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - 2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.
- I. Alarm Generation:
 - 1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
 - 2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
 - 3. Controller shall be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
- J. The controller processor shall be a 32-bit processor.
- K. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.6 TERMINAL UNIT APPLICATION CONTROLLERS (AC UNITS, FAN COILS)

- A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers objects listed in object list for unit. Controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. BACnet Conformance:

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1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group.
 - b. Reinitialize Functional Group.
 - c. Device Communications Functional Group.
 2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that shall be directly supported to provide each of the functional groups listed above. Proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5VDC, 4-20mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. Program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. Program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. Programming tools shall be provided and installed as part of system.
- 2.7 APPLICATION SPECIFIC CONTROLLERS (ASC)
- A. Each DDC Controller shall be able to extend its performance and capacity using remote application specific controllers (ASCs) through LAN Device Networks.
 - B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASCs as a minimum:
 1. Terminal Equipment Controllers

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- a. Terminal Box (VAV box controllers) should have a differential pressure transmitter (transducer) accuracy of 0.015-inches w.g. or less.
- C. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.
- D. Terminal Equipment Controllers:
 - 1. Provide for control of each piece of equipment , including, but not limited to, the following:
 - a. Terminal Units
 - b. Exhaust fans
 - c. Fan Coil Units

2.8 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters and Resistance Temperature Detectors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment (classrooms, offices, work rooms and conference rooms): Exposed warmer/cooler slider. Range of adjustment capable at zone sensor shall be programmable through the BAS.
 - b. Set-Point Adjustment (other spaces): Concealed.
 - c. Set-Point Indication: Concealed.
 - d. Thermometer: Concealed.
 - e. Color: Manufacturer's standard.
 - f. Orientation: Vertical.
 - g. Option: No manufacturer logo.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Public Corridors: In public corridors and entrances, provide blank stainless-steel cover plate sensors with insulated back and security screws.
- C. Humidity Sensors: Capacitance or bulk polymer resistance type.
 - 1. Accuracy: 5 percent full range with linear output.

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2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Color: Manufacturer's standard.
 - b. Orientation: Vertical.
 - c. Set-Point Adjustment: Concealed.
 - d. Set-Point Indication: Concealed.
4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 0 to 185 deg F.
5. Duct-Mounted: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

D. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input and temperature-compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential. Accuracy shall be +/- 5% of range.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

E. Current Sensing Switch:

1. Sensor supply voltage and supply current shall be induced from monitored conductor. Contact rating shall be 0.2 amperes at 30 volts DC/AC. Trip set point shall be adjustable to +/-1% of range. Current sensing switch wiring shall not be polarity sensitive.

F. Liquid Level Sensors:

1. Liquid level sensors shall have 1/2" accuracy calibrated to detect water in temperature range from 60°F to 80°F. Output signal shall be 4 to 20 mA. Sensor material shall be stainless steel or other non-corrosive material.

2.9 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

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- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- F. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- G. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.10 CARBON DIOXIDE SENSORS AND TRANSMITTERS

- A. Manufacturer:
 - 1. Vaisala – GM20 series
- B. Carbon Dioxide Sensor and Transmitter:
 - 1. Single detectors using solid-state infrared sensors; suitable over a temperature range of 32 to 122 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
 - 2. Silicon-based non-dispersive infrared sensor.
 - 3. Five year recommended calibration interval.
 - 4. Warranty: Two years.

2.11 FLOW MEASURING STATIONS

- A. Duct Airflow Station:
 - 1. Qualifications: The manufacturer shall have a minimum of ten years experience producing products of this type.
 - 2. Acceptable Manufacturers: Subject to compliance with requirements, provide products by Ebtron Inc. Unless otherwise noted model numbers shall be as follows:
 - a. Model GTx116-PC for ducts and plenums.
 - b. Model GTx116-F for fan inlet applications.

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3. Alternative Manufacturers: Alternative manufacturers may be submitted as a substitution in accordance with Division 1 specification requirements. Superior performance or lower cost to the owner must be provided. Acceptance shall be at the sole discretion of the Architect.
4. Special Warranty: In addition to other required warranties provide 3 years on parts from the date of unit shipment.
5. Delivery, Storage and Handling: All handling and storage procedures shall be per manufacturer's recommendations. Airflow measuring devices shall be kept clean and dry, protected from weather and construction traffic.
6. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
7. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings, calculated for each sensor housing, shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.
8. Sensor Probe Assemblies:
 - a. Sensor housings shall be manufactured of a U.L. listed engineered thermoplastic.
 - b. Sensor housings shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
 - c. Sensor housings shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range.
 - d. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - e. Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
 - f. Operating temperature range for the sensor probe assembly shall be -20° F to 160° F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
 - g. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15° F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - h. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
 - i. Each sensor assembly shall not require matching to the transmitter in the field.
 - j. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.
9. Duct and Plenum Sensor Probe Assemblies:
 - a. Sensor housings shall be mounted in an extruded, 6063 aluminum tube probe assembly.

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- b. Thermistor probes shall be mounted in sensor housings using an epoxy resin.
- c. All thermistor probe wires shall be contained within the aluminum tube probe assembly.
- d. The number of sensor housings provided for each location shall be as follows:

1)	Area (sq.ft.)	Sensors
2)	<2	4
3)	2 to <4	6
4)	4 to <8	8
5)	8 to <16	12
6)	>=16	16

- e. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:

- 1) Insertion mounted through the side or top of the duct
- 2) Internally mounted inside the duct or plenum
- 3) Standoff mounted inside the plenum

- f. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated.

10. Fan Inlet Sensor Probe Assemblies:

- a. Sensor housings shall be mounted on 304 stainless steel blocks.
- b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
- c. Mounting feet shall be constructed of 304 stainless steel.
- d. The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated.

11. Transmitters:

- a. The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
- b. The transmitter shall be capable of:
 - 1) Independently monitoring and averaging up to 16 individual airflow and temperature readings.
 - 2) Displaying the airflow and temperature readings of individual sensors on the LCD display.
- c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.
- d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
- e. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.

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- f. The transmitter shall be capable of communicating with the BAS using one of the following interface options:
 - 1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire)
 - 2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus
 - 3) Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP
 - 4) LonWorks Free Topology
 - g. The transmitter shall have an infra-red interface capable of downloading individual sensor airflow and temperature data or uploading transmitter configuration data to a handheld PDA (Palm or Microsoft Pocket PC operating systems).
 - h. The measuring device shall be UL listed as an entire assembly.
 - i. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated. A written report shall be submitted to the architect should any measurement location not meet the manufacturer's placement requirements.
12. Installation: Install in accordance with manufacturer's instructions at locations indicated. A written report shall be submitted to the architect if any discrepancies are found.
13. Adjusting: Duct and plenum devices shall not be adjusted without the Architect's approval.

2.12 THERMOSTATS

A. Available Manufacturers:

- 1. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
- 2. Heat-Timer Corporation.
- 3. tekmar Control Systems, Inc.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

- 1. Label switches "FAN ON-OFF" or "FAN HIGH-LOW-OFF" or "FAN HIGH-MED-LOW-OFF."
- 2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

- 1. Automatic switching from heating to cooling.
- 2. Preferential rate control to minimize overshoot and deviation from set point.
- 3. Set up for four separate temperatures per day.
- 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
- 5. Short-cycle protection.
- 6. Programming based on every day of week.

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7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 2. Selector Switch: Integral, manual on-off-auto.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- H. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

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1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.13 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Non-spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 4. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 5. Non-spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 6. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

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- f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
- 3. Coupling: V-bolt and V-shaped, toothed cradle.
- 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
- 6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
- 7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
- 8. Temperature Rating: Minus 22 to plus 122 deg F.
- 9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.14 DAMPERS

- A. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.15 SMOKE DETECTORS

- A. Smoke detectors shall be furnished under Division 28 and installed under this Section.
- B. Wiring from smoke detectors to fire alarm system shall be under Division 28.
- C. Wiring from smoke detectors to mechanical equipment shall be under this Section.

2.16 Low Temperature Detection Stat: By BAS manufacturer.

2.17 CARBON MONOXIDE SENSOR/TRANSMITTER

- A. The carbon monoxide sensor/transmitter shall provide carbon monoxide levels in the vehicle sallyport and control the ventilation system in accordance with all applicable codes and standards.

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- B. The sensors shall be electrochemical type. The sensor/transmitter shall have plug-in technology for ease of troubleshooting and replacement of both the element and the printed circuit board.
 - C. The sensor range shall be 0-250 ppm carbon monoxide. A microprocessor-based transmitter shall generate a polarity protected, proportional 4-20 mA output signal. The wiring between the transmitter and the controller shall be a 2-wire, twisted and shielded, 4-20mA, 17-28 VDC configuration. Each sensor/transmitter shall cover between 5,000 and 10,000 square feet of the garage floor and placement shall be applied strategically and appropriately per floor plan requirements.
 - D. The sensor shall have stability and resolution of ± 0.5 ppm of reading, repeatability of $\pm 2\%$ of reading, and a response time of 30 seconds to a 90% step change. The long-term output drift shall not exceed more than 0.4% of signal loss per month. The permissible ambient working temperature shall be 14°F to 104°F and permissible ambient humidity shall be 15 to 95% RH, non-condensing. The sensor shall require no routine maintenance other than periodic calibration. Its life expectancy shall be 5 years of normal service. The manufacturer shall provide a two 2-year warranty for materials and workmanship, and a 12-month warranty on the sensing element under normal exposure.
 - E. The sensor/transmitter printed circuit board shall have the capability of adding up to (2) alarm relays with individual set-points for local control or status indication.
 - F. The sensor/transmitter shall be RFI/EMI protected and contained in a NEMA 1 metal enclosure to prevent vandalism. The enclosure for the sensor/transmitter shall be installed on walls or columns approximately 5 feet above the floor.
 - G. The output signal from the sensor/transmitter shall be a direct input to the controller. All sequences of fan and alarm control, including time delay functions to prevent hunting of ventilation fans shall be a part of the controller.
 - H. The sensor/transmitter shall be NRTL performance tested and certified to ANSI/UL 2075.
- 2.18 CURRENT SENSING RELAYS: By controls contractor for all equipment.
- 2.19 miscellaneous relays and switches:
- A. General: Where required by the sequence of operation switches, relays, and miscellaneous devices necessary to accomplish the sequence shall be provided under this Section.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 - 1. Construct and maintain project schedule

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2. On-site coordination with all applicable trades and subcontractors
3. Authorized to accept and execute orders or instructions from owner/architect
4. Attend project meetings as necessary to avoid conflicts and delays
5. Make necessary field decisions relating to this scope of work
6. Coordination/Single point of contact.

3.2 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified in Section 23 section "Sequence of Control."
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices next to light switch(es) when space is available with top of device at 48 inches above finished floor. Where space next to light switch(es) is not available, align device vertically with light switch and locate device with top at 40 inches above the finished floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats where indicated on Drawings.
- E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

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3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 7. Check temperature instruments and material and length of sensing elements.
 - 8. Check control valves. Verify that they are in correct direction.
 - 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate instruments.

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2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. 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 three visits to Project during other than normal occupancy hours for this purpose.

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3.6 TRAINING

- A. Provide 16 hours of training for Owner's designated operating personnel. Training shall include:
1. Explanation of drawings and operation & maintenance manuals
 2. Walk-through of the job to locate control components
 3. Operator workstation and peripherals
 4. Operation of Portable computer
 5. DDC controller and ASC operation/function
 6. Operator control functions including graphic generation and field panel programming
 7. Explanation of adjustment, calibration and replacement procedures
- B. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If necessary additional training will be contracted by the Owner at a later date.
- C. Coordinate with Owner if video recorded documentation of training is required.

END OF SECTION 230900

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SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "Building Automation System" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CO₂: Carbon dioxide.
- C. CO: Carbon monoxide
- D. DDC: Direct digital control.
- E. PPM: Parts per million.
- F. RPM: Revolutions per minute.
- G. SCR: Silicon-Controlled Rectifier.
- H. TAB: Testing, Adjusting and Balancing.
- I. VAV: Variable air volume.
- J. VFD: Variable-frequency drive

1.4 GENERAL REQUIREMENTS OF THIS SECTION

- A. Control sequences shall be accomplished in accordance with control drawings and the sequences specified in this section. It is the intent of this section to utilize sequences included in pre-programmed controllers when such sequences provide the intended operation.

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- B. Points may not be deleted without prior approval from the Architect.
- C. Every attempt has been made to indicate all required points on the control drawings. Occasionally an additional point, or points, may be required to accomplish a specified sequence. The contractor performing work under this section shall understand the work to be implied and required by the contract documents. Additional hardware and software required shall be provided under section "Building Automation System" at no additional cost to the Owner.
 - 1. Such points include:
 - a. Sensors of all types whether or not specified under section "Building Automation System"
 - b. Air flow measuring stations.
 - c. Wiring, conduit, and related devices such as relays.
 - 2. Exceptions:
 - a. Equipment and devices covered under sections other than "Building Automation System".

1.5 DISPLAY GRAPHICS:

- A. Include system schematic for each system. Indicate all points in system on at least one graphic.
- B. Indicate all commanded values and temperatures.
- C. Indicate all sensed temperatures.
- D. Indicate all alarms.
- E. Indicate all status points.
- F. Indicate all monitored conditions.

1.6 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Final Acceptance.

1.7 SUBMITTALS

- A. Refer to Section "Building Automation System."

PART 2 - SEQUENCES

- 2.1 SET POINTS: Unless indicated otherwise all set points shall be adjustable from the head end.
- 2.2 OCCUPIED / UNOCCUPIED

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- A. The BAS shall institute occupied and unoccupied control sequences based on a time-of-day schedule furnished by the Owner.
- B. The Owner shall have the capability to program holidays and special functions.
- C. The owner shall have the ability to override occupied / unoccupied maintenance / and unoccupied operation of each piece of equipment from the head end.

2.3 OPTIMUM START:

- A. The BAS shall institute optimum start strategies for morning warm up and cool down functions. Equipment shall start early enough to restore occupied temperature set points 30 minutes prior to occupancy.

2.4 OUTSIDE AIR SENSORS:

- A. Temperature: The BAS shall monitor outside air temperature as sensed by the outside air temperature sensor.
- B. Humidity: The BAS shall monitor outside air relative humidity as sensed by the outside air humidity sensor.

2.5 PACKAGED VAV ROOFTOP UNITS SERVING TERMINAL UNITS

- A. General: This air handling unit includes a variable speed supply and exhaust fans w/VFD's or variable speed ECM motors, modulating outside air damper, modulating return air damper, modulating & staged packaged direct expansion cooling, gas heat exchanger, and outdoor air flow measuring station. It provides temperature and humidity control for terminal units. Unit is capable of 100% airside economizer operation. Units serving classroom spaces will be controlled by CO₂ sensor(s) and airflow measuring station in outside airstream for outside air control.
- B. Unit controls are factory installed and provided by unit manufacturer to meet the general intent as indicated below.
- C. Initial Set Points:
 - 1. Occupied:
 - a. Minimum Leaving Air Temperature: 55°F.
 - b. Maximum Leaving Air Temperature: 65°F.
 - c. Space Relative Humidity: 55% RH
 - d. CO₂: Outside Air CO₂ PPM + 400 PPM
 - 2. Unoccupied:
 - a. Minimum Leaving Air Temperature: 55°F.
 - b. Maximum Leaving Air Temperature: 65°F.
 - c. Space Relative Humidity: 60% RH
 - d. CO₂: NA (Outside air dampers closed/relief fan off)

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D. Enable/Disable:

1. Occupied Operation: During occupied hours, the unit shall be enabled, the supply fan shall be started, and dampers shall modulate in accordance with applicable sequences below.
2. Unoccupied Operation: During unoccupied hours, the supply fan shall be cycled on and off to maintain unoccupied set points with outdoor air damper (D-1) closed and return air damper (D-2) open.
 - a. Unoccupied Heating: Should any of the unoccupied space temperatures fall below the unoccupied heating space temperature set point (control to worst case zone), the unit shall be started in the warm-up mode until the space (worst case zone) temperature rises 5°F above the unoccupied heating space temperature set point.
 - b. Unoccupied Cooling: Should any of the unoccupied space temperatures rise above the unoccupied cooling space temperature set point (control to worst case zone), the unit shall be started in the cool-down mode until the space (worst case zone) temperature falls 5°F below the unoccupied cooling space temperature set point.
 - c. Unoccupied Humidity Control: If the space relative humidity rises above the unoccupied space relative humidity set point (as sensed by the return duct relative humidity sensor), the unit shall operate in the cool-down mode until the relative humidity drops 5% RH below the unoccupied space relative humidity set point.
3. Warm-up Operation: The BAS shall optimize the early start of the unit in warm-up mode to reach the occupied space heating set point by the occupied time. During warm-up operation the outside air damper (D-1) shall be closed and return air damper (D-2) open.
4. Cool-down Operation: The BAS shall optimize the early start of the unit in cool-down mode to reach the occupied space cooling set point by the occupied time. During cool-down operation the outside air damper (D-1) shall be closed and return air damper (D-2) open.
5. Startup: Start time shall be based on the BAS optimum start programming in accordance with a predetermined schedule to be furnished by the Owner and programmed into the BAS. The outside air damper shall remain closed while the unit operates in warm-up/cool-down mode to restore occupied set points. At occupancy time, the unit shall begin to modulate the outside air damper in accordance with its sequence of control.

E. Supply Fan Control:

1. During unoccupied hours, the fan shall be cycled as necessary to maintain worst case zone set points. When fan is cycled on, control shall be similar to occupied operation.
2. During occupied hours, the supply fan shall be started at its minimum speed. The required speed shall be determined by the equipment manufacturer and shall be instituted as the minimum fan speed.
3. Speed Control:
 - a. A static pressure sensor shall be located two-thirds down furthest duct run. The static pressure sensor shall function as the control input to the BAS (and thus to the supply fan VFD) such that a fall in down-duct static pressure will result in a proportional increase in supply fan speed to maintain set point. The static pressure set point shall be determined in accordance with "Down-duct Static Pressure Set Point" below. On a rise in down-duct static pressure, the reverse shall occur. Initial maximum static pressure set-point shall be 1.0 inches W.G. and shall be adjustable.
 - b. Down-duct Static Pressure Set Point: The BAS shall continuously monitor the damper position (air valve) of all terminal units. When any damper opens beyond

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the maximum set point (initially 95%), the BAS shall reset the down-duct static pressure set point upward by 5% (adjustable) of the maximum static pressure set point. This shall occur at 10 minute (adjustable) intervals until no damper is more than 95% open, or the static pressure set point has been reset upward to the system maximum setting, or the VFD is at its maximum setting. When all dampers are opened less than the minimum set point (initially 85%), the BAS shall reset the down-duct static pressure set-point downward by 5% (adjustable) of the maximum system static pressure set point. This shall occur at 10 minute (adjustable) intervals until any damper is more than 85% open, or the VFD is at its minimum setting.

- c. A second high limit static pressure sensor located in the supply fan discharge duct shall function as a safety input to the BAS. An increase in fan discharge static pressure above set point (initially 4 inches w.g.) shall cause the BAS to stop the supply fan. An alarm shall be sent to the BAS that the unit has been shut down due to fan over-speed.
 4. Drive Malfunction: Should the VFD malfunction as indicated by drive alarm circuit, an alarm shall be sent to the head end. The fan shall continue to operate unless deactivated by the VFD protection circuitry.
 5. Fan Failure Alarm: Should the supply fan fail (sensed by its current sensing relay), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
 6. CO₂ Control: Whenever the outside air damper is completely open and CO₂ concentration rises above set point, the BAS shall override temperature control and shall modulate fan speed from minimum to maximum as required to maintain CO₂ set point.
- F. Exhaust Fan Control:
1. During unoccupied hours, the fan shall be disabled.
 2. During occupied hours, the fan shall be disabled.
 3. During economizer operation, the fan shall be controlled to maintain building pressure at setpoint (initially +0.05" wg) and ramp up as much as the maximum design airflow.
 4. Drive Malfunction: Should the VFD malfunction as indicated by drive alarm circuit, an alarm shall be sent to the head end. The fan shall continue to operate unless deactivated by the VFD protection circuitry.
 5. Fan Failure Alarm: Should the exhaust fan fail (sensed by its current sensing relay), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
- G. Economizer Mode: Whenever outside air enthalpy is less than return air enthalpy and cooling is required, economizer operation shall be enabled.
1. Economizer operation shall be available twenty-four hours per day and shall override unoccupied damper controls.
 2. Economizer Mode shall be disabled during dehumidification mode.
 3. Economizer mode shall be disabled when outside air dry-bulb temperatures exceed 65 degrees F.
- H. Dehumidification Mode: During occupied or unoccupied operation when the relative humidity (as sensed by the return duct relative humidity sensor) rises above set point, the unit shall be placed in dehumidification mode. The unit shall reset the leaving air temperature set point to minimum. The unit shall remain in dehumidification mode until the relative humidity drops to

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5% RH below set point at which time the unit shall return to normal leaving air temperature reset control. Refer to applicable paragraphs for operation of valves, dampers, and fans.

- I. Cooling Control: The unit shall confirm the gas heating burner is disabled and supply fan is running before enabling cooling. If cooling is required, the direct expansion packaged cooling shall modulate the lead circuit (variable speed) as the first state of cooling, where if additional capacity is needed, it should stage on the other compressors and modulate the lead circuit (variable speed) to maintain the leaving air temperature set point (as sensed by the temperature sensor located in the discharge of unit). Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer. Leaving air temperature shall be controlled to maintain the leaving air temperature set point by plus or minus 1.5°F.
- J. Heating Control: The unit shall confirm the DX cooling is disabled and supply fan is running before enabling heating. If heating is required, gas heating coil shall modulate capacity (staged) to maintain the leaving air temperature set point (as sensed by the temperature sensor located in the discharge of unit). Leaving air temperature shall be controlled to maintain the leaving air temperature set point by plus or minus 5°F. Gas heating by the RTU is for emergency purposes and/or morning warm-up.
- K. Leaving Air Temperature Reset:
 - 1. Whenever all of terminal VAV boxes are at 75% or less (adjustable) of their maximum airflow, the leaving air temperature set point shall be increased 1°F (adjustable) every 10 minutes (adjustable) until the leaving air temperature set point is reset up to its maximum. If any terminal VAV boxes rise above 75% of their maximum airflow, the inverse shall occur.
 - 2. Whenever any terminal VAV box is at its maximum airflow the leaving air temperature set point shall be reset to its minimum.
 - 3. Whenever all terminal VAV boxes are in heating mode, the leaving air temperature shall be reset up to its maximum.
- L. Outdoor Air Damper (D-1):
 - 1. Unoccupied: Damper shall be fully closed. The damper end switch shall confirm the damper is closed. If the damper fails to close, an alarm shall be sent to the head end identifying the unit and stating that the outdoor damper failed to close.
 - 2. Occupied: The damper shall modulate to open inversely with the return air damper (D-2) to maintain scheduled outdoor air (as sensed by the outdoor air flow measuring station). If the damper fails bring in design outdoor air within +/-10% after 5 minutes (adjustable), an alarm shall be sent to the head end identifying the unit and stating that the unit is not providing design outdoor air.
 - 3. Economizer: The damper shall modulate to open inversely with the return air damper (D-2) to maintain above scheduled outdoor air (as sensed by the outdoor air flow measuring station) to maintain leaving air temperature as the first stage of cooling.
 - 4. Occupied: The BAS shall modulate dampers to provide the minimum outdoor air necessary to maintain CO₂ at set point (as sensed by the CO₂ sensor). At 150 PPM below set point, the dampers shall be closed. At 50 PPM above set point, the damper shall open to provide the scheduled maximum outdoor air (as sensed by the air flow measuring sensor).
- M. Return Air Damper (D-2):

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1. Unoccupied: Damper shall be fully open. The damper end switch shall confirm the damper is open. If the damper fails to open, an alarm shall be sent to the head end identifying the unit and stating that the return damper failed to open.
 2. Occupied: The damper shall modulate to close inversely with the outdoor air damper (D-1) to maintain scheduled outdoor air (as sensed by the outdoor air flow measuring station).
 3. Economizer: The damper shall modulate to close inversely with the outdoor air damper (D-1) to maintain above scheduled outdoor air (as sensed by the outdoor air flow measuring station) to maintain leaving air temperature as the first stage of cooling.
- N. Life Safety: Duct smoke detectors located in the return air duct, upon detection of products of combustion from any detector, signal the building fire alarm system and shut down the unit & supply fan. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.
- O. System Safety: Whenever the supply fan is stopped or airflow ceases for any reason (as sensed by the motor status sensing circuit), the supply fan shall be deactivated and alarm issued to BAS. The outdoor air damper (D-1) shall be closed and return damper (D-2) open. In all modes of operation, commanded position values for all control devices such as dampers shall be readable from the head-end.
- P. Condensate Pan Overflow Prevention: The unit shall monitor float switches in the condensate pan under the evaporator. If the float switch detects the pan is about to overflow and has reached its high limit, the unit shall disable the cooling and issue an alarm to the BAS.
- Q. Filter Change Alarm: The differential pressure across the filters shall be monitored, where if the differential pressure exceeds 1" wg (adjustable), an alarm is issued to BAS.

2.6 TERMINAL UNIT WITH ELECTRIC HEATING COIL

- A. DESCRIPTION: Cooling & heating coil, ceiling mounted, primary air control, variable air volume terminal unit. The unit contains a characterized damper, a pitot type velocity measuring device with transducer, and an electric heating coil. The velocity of air, as sensed by the velocity sensor/transducer combination using a calculation with a known diameter provides flow (CFM) information to the BAS. The temperature of the space, as sensed by the space temperature sensor, allows the controller to determine the required CFM for cooling, when to start the electric heating coil, and what capacity to require from the electric heating coil.
- B. Set points
1. Occupied Mode:
 - a. Cooling: 75° F
 - b. Heating: 70° F
 2. Unoccupied:
 - a. Cooling: 85° F
 - b. Heating: 55° F
- C. Cooling:

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1. On a rise in space temperature, as sensed by the space temperature sensor, above the cooling set point, the BAS shall modulate the terminal unit air valve open in response to the increase in space temperature until the maximum cooling indicated CFM is reached.
2. On a fall in space temperature, as sensed by the space temperature sensor, the reverse shall occur until the minimum cooling indicated CFM is reached.

D. Heating:

1. On a fall in space temperature, as sensed by the space temperature sensor, the BAS shall adjust the air valve to maintain the scheduled heating indicated CFM and modulate the heating coil controls to maintain space temperature.
2. On a rise in space temperature, as sensed by the space temperature sensor, the reverse shall occur.

E. Monitoring points: The following information shall be sent to the BAS by the unitary controller and subsequently displayed on the head end graphics.

1. Electric Heating coil status.
2. Alarm for zone temperature too high or too low.
3. Air valve position feedback.
4. Measured/calculated primary air flow rate
5. Discharge air temperature.
6. Zone temperature

F. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.

2.7 PARALLEL FAN POWERED TERMINAL UNIT WITH ELECTRIC HEAT

A. DESCRIPTION: Cooling & heating with electric heating coil, ceiling mounted, series (constantly operating fan with primary air through fan) fan powered, primary air control, variable air volume terminal unit. The unit contains a characterized damper, a pitot type flow measuring device with transducer, a fan in series with primary air, and a heating coil. The velocity of air, as sensed by the flow sensor/transducer combination using a calculation with a known diameter provides flow (CFM) information to the BAS. The temperature of the space, as sensed by the space temperature sensor, allows the controller to determine the required CFM for cooling, when to start the fan, when to modulate the heating coil, and what capacity to require from the heating coil. Set points

1. Occupied Mode:
 - a. Cooling: 75° F
 - b. Heating: 70° F
2. Unoccupied Mode:
 - a. Cooling: 85° F
 - b. Heating: 55° F

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- B. Cooling:
1. On a rise in space temperature, as sensed by the space temperature sensor, above the cooling set point, the BAS shall modulate the terminal unit air valve open in response to the increase in space temperature until the maximum indicated CFM is reached. The back draft damper to the fan shall remain closed.
 2. On a fall in space temperature, as sensed by the space temperature sensor, the reverse shall occur until the minimum indicated CFM is reached.
- C. Heating:
1. On fall in space temperature, as sensed by the space temperature sensor, to the heating set point the BAS shall start the terminal unit fan and open the back draft damper.
 2. On a continued fall in space temperature, as sensed by the space temperature sensor, the BAS shall modulate the heating coil to maintain space temperature.
 3. On a rise in space temperature, as sensed by the space temperature sensor, the reverse shall occur.
- D. Fan:
1. On during occupied mode and should be cycled on/off during unoccupied mode to maintain heating set point.
- E. Monitoring points: The following information shall be sent to the BAS by the unitary controller and subsequently displayed on the head end graphics.
1. Electric heating coil status.
 2. Alarm for zone temperature too high or too low.
 3. Air valve position feedback.
 4. Measured/calculated primary air flow rate
 5. Discharge air temperature.
 6. Fan status
 7. Zone temperature
- F. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.

2.8 DUCTLESS SPLIT SYSTEM HEAT PUMPS

- A. General: This ductless split system unit shall be controlled by manufacturer's standard thermostat controls. It provides temperature control for a single zone.
- B. Initial Set Points:
- a. Cooling: 70°F
 - b. Heating: 60°F
- C. Supply Fan Control:

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1. During unoccupied hours, the fan shall be cycled as necessary to maintain set points.
 2. During occupied hours, the fan shall be cycled as necessary to maintain set points.
- D. Cooling Control: If cooling is required, the direct expansion cooling shall modulate to maintain the space set point. Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer.
- E. Heating Control: If heating is required, the direct expansion heat pump shall modulate to maintain the space set point. Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer.
- F. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.
- G. Condensate Pan Overflow Prevention: BAS shall monitor float switches in the condensate trap at the evaporator. If the float switch detects the condensate is not draining, the BAS shall disable the cooling and issue an alarm to the BAS.
- H. Space Temperature Monitoring: The BAS shall monitor the space temperature, if temperature rises 10°F above the cooling set point, an alarm shall be issued to the head end identifying the room.
- 2.9 PACKAGED ELECTRIC COOLING/GAS HEAT UNITS (5 tons and less)
- A. General: This unit includes a constant speed supply fan, selectable heating and cooling modes. It provides temperature control for a single zone.
- B. Initial Set Points:
1. Occupied:
 - a. Cooling: 75°F
 - b. Heating: 70°F
 2. Unoccupied:
 - a. Cooling: 85°F
 - b. Heating: 55°F
- C. Supply Fan Control:
1. During unoccupied hours, the fan shall be cycled as necessary to maintain set points.
 2. During occupied hours, the fan shall be cycled as necessary to maintain set points.
- D. Cooling Control: If cooling is required, the direct expansion cooling shall stage on to maintain the space set point in cooling mode. Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer.
- E. Heating Control: If heating is required, the heat exchanger shall stage on to maintain the space set point in heating mode.
- F. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.

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- G. Condensate Pan Overflow Prevention: BAS shall monitor float switches in the condensate pan under the evaporator. If the float switch detects the pan is about to overflow and has reached its high limit, the BAS shall disable the cooling and issue an alarm to the BAS.
- H. Outdoor Air Damper (BAS controlled):
 - 1. Unoccupied: Damper shall be fully closed. The damper end switch shall confirm the damper is closed. If the damper fails to close, an alarm shall be sent to the head end identifying the unit and stating that the outdoor damper failed to close.
 - 2. Occupied: Damper shall be fully open.

2.10 ROOFTOP UNITS (SINGLE ZONE) WITH ENERGY RECOVERY

- A. General: This air handling unit includes a constant speed supply and exhaust fan, outside air damper, relief air damper, modulating & staged packaged direct expansion cooling, gas furnace heating, outdoor air flow measuring station and a pre-conditioning enthalpy wheel. It provides temperature and humidity control for a single zone. Unit controls are factory installed and provided by unit manufacturer to meet the general intent as indicated below. Units are anticipated to operate 24/7 so no unoccupied sequence is given.
- B. Initial Set Points:
 - 1. Occupied:
 - a. Cooling: 75°F, 50% RH
 - b. Heating: 70°F
- C. Enable/Disable:
 - 1. Occupied Operation: During occupied hours, the unit shall be enabled, the supply and exhaust fan shall be started, and dampers shall modulate in accordance with applicable sequences below.
- D. Supply Fan Control:
 - 1. During occupied hours, the supply fan shall deliver design airflow.
 - 2. Fan Failure Alarm: Should the supply fan fail (sensed by its current sensing relay), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
- E. Exhaust Fan Control:
 - 1. During occupied hours, the exhaust fan shall deliver design airflow.
 - 2. Fan Failure Alarm: Should the exhaust fan fail (sensed by its current sensing relay), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
- F. Enthalpy Wheel:
 - 1. Occupied Mode: On
 - a. Economizer Mode: The unit should monitor outside air conditions to prevent over recovery, where between 75°F (adjustable) and the supply air temperature set point the wheel shall be disabled to prevent unnecessary pre-heating.
 - b. Capacity Modulation: The unit should vary the wheel speed to prevent over recovery (pre-heat/pre-cool) to be used as the first stage of heating and cooling.

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2. Frost Control: None
 3. Alarm: Should the enthalpy wheel motor fail (as sensed by its current sensing relay or rotation sensor) an alarm shall be sent to the head end identifying the unit and stating that the enthalpy wheel motor has failed.
- G. Dehumidification Mode: When the space relative humidity rises above set point, the unit shall be placed in dehumidification mode. Cooling shall be maximized and hot gas reheat modulated to maintain space temperature set point. The unit shall remain in dehumidification mode until the relative humidity drops to 5% RH below set point at which time the unit shall return to normal mode. Refer to applicable paragraphs for operation of valves, dampers, and fans.
- H. Cooling Control: The unit shall confirm the supply fan is running before enabling cooling. If cooling is required, the direct expansion packaged cooling shall modulate the lead circuit (variable speed) as the first state of cooling, where if additional capacity is needed, it should stage on the other compressors and modulate the lead circuit (variable speed) to maintain the space set point. Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer.
- I. Heating Control: The unit shall confirm the DX cooling is disabled and supply fan is running before enabling heating. If heating is required, the unit shall utilize the gas heat exchanger.
- J. Economizer Mode: Whenever outside air enthalpy is less than return air enthalpy and cooling is required, economizer operation shall be enabled. Bypass dampers shall be full open, cooling, heating and hot gas reheat modes shall be disabled. Outdoor and relief air dampers shall be fully open. Enthalpy wheel shall be disabled.
- K. Outdoor Air Damper (D-1):
 1. Occupied: The damper shall modulate fully open.
- L. Relief Air Damper (D-2):
 1. Occupied: The damper shall modulate fully open.
- M. Space Temperature: For secure zones space temperature shall be sensed using the temperature sensor mounted in the return duct. For non-secure zones, space temperature shall be sensed using the wall mounted temperature sensor located as indicated.
- N. Space Humidity: For secure zones space humidity shall be sensed using the humidity sensor mounted in the return duct. For non-secure zones, space humidity shall be sensed using the wall mounted humidity sensor located as indicated.
- O. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.
- P. Life Safety: Duct smoke detectors located in the return/exhaust air duct, upon detection of products of combustion from any detector, signal the building fire alarm system and shut down the unit & supply fan. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.
- Q. System Safety: Whenever the supply fan is stopped or airflow ceases for any reason (as sensed by the motor status sensing circuit), the supply fan shall be deactivated and alarm issued to

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BAS. The outdoor air damper (D-1) shall be closed and relief damper (D-2) open. In all modes of operation, commanded position values for all control devices such as dampers shall be readable from the head-end.

- R. Condensate Pan Overflow Prevention: The unit shall monitor float switches in the condensate pan under the evaporator. If the float switch detects the pan is about to overflow and has reached its high limit, the unit shall disable the cooling and issue an alarm to the BAS.
- S. Filter Change Alarm: The differential pressure across the filters shall be monitored, where if the differential pressure exceeds 1" wg (adjustable), an alarm is issued to BAS.

2.11 PACKAGED SINGLE ZONE VAV ROOFTOP UNIT (packaged gas/electric units over 5 tons)

- A. General: This air handling unit includes a variable speed supply and exhaust fan, modulating outside air damper, modulating return air damper, modulating & staged packaged direct expansion cooling, and gas heat exchanger. It provides temperature and humidity control for a single zone. Unit controls are factory installed and provided by unit manufacturer to meet the general intent as indicated below.
- B. Initial Set Points:
 - 1. Occupied:
 - a. Cooling: 75°F, 50% RH
 - b. Heating: 70°F
 - 2. Unoccupied:
 - a. Cooling: 85°F
 - b. Heating: 55°F
- C. Enable/Disable:
 - 1. Occupied Operation: During occupied hours, the unit shall be enabled, the supply and exhaust fan shall be started, and dampers shall modulate in accordance with applicable sequences below.
 - 2. Unoccupied Operation: During unoccupied hours, the supply fan shall be cycled on and off to maintain unoccupied set points with outdoor air damper (D-1) closed and return air damper (D-2) open.
 - a. Unoccupied Heating: Should the space temperature fall below the unoccupied heating space temperature set point, the unit shall be started in the warm-up mode until the space temperature rises 5°F above the unoccupied heating space temperature set point.
 - b. Unoccupied Cooling: Should the space temperature rise above the unoccupied cooling space temperature set point, the unit shall be started in the cool-down mode until the space temperature falls 5°F below the unoccupied cooling space temperature set point.
 - c. Unoccupied Humidity Control: If the space relative humidity rises above the unoccupied space relative humidity set point, the unit shall operate in the dehumidification mode until the relative humidity drops 5% RH below the unoccupied space relative humidity set point.
 - 3. Warm-up Operation: The BAS shall optimize the early start of the unit in warm-up mode to reach the occupied space heating set point by the occupied time. During warm-up operation the outside air damper (D-1) shall be closed and return air damper (D-2) open.

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4. Cool-down Operation: The BAS shall optimize the early start of the unit in cool-down mode to reach the occupied space cooling set point by the occupied time. During cool-down operation the outside air damper (D-1) shall be closed and return air damper (D-2) open.
 5. Startup: Start time shall be based on the BAS optimum start programming in accordance with a predetermined schedule to be furnished by the Owner and programmed into the BAS. The outside air damper shall remain closed while the unit operates in warm-up/cool-down mode to restore occupied set points. At occupancy time, the unit shall begin to modulate the outside air damper in accordance with its sequence of control.
- D. Supply Fan Control:
1. Supply Fan Control:
 - a. When the unit is started, the supply fan will go to its minimum speed. The required speed shall be determined by the equipment manufacturer and shall be instituted as the minimum fan speed.
 - b. Speed Control:
 - 1) The supply fan speed shall be modulated to maintain space temperature set point (as sensed by the space temperature sensor).
 - c. Drive Malfunction: Should the VFD malfunction as indicated by drive alarm circuit, an alarm shall be sent to the head end. The fan shall continue to operate unless deactivated by the VFD protection circuitry.
 - d. Fan Failure Alarm: Should the supply fan fail (sensed by its differential pressure sensor), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
- E. Exhaust Fan Control (where specified):
1. During unoccupied hours, the fan shall be disabled.
 2. During occupied hours, the exhaust fan shall deliver design airflow during economizer mode.
 3. Fan Failure Alarm: Should the exhaust fan fail (sensed by its current sensing relay), the unit shall be disabled, and an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed.
- F. Cooling Control: The unit shall confirm the supply fan is running before enabling cooling. If cooling is required, the direct expansion packaged cooling shall modulate the lead circuit as the first state of cooling, where if additional capacity is needed, it should stage on the other compressors to maintain the space set point. Condenser fans shall be staged per each circuit or as recommended by equipment manufacturer.
- G. Heating Control: The unit shall confirm the supply fan is running and DX cooling is disabled before enabling heating by the gas heat exchanger.
- H. Dehumidification Mode: During occupied or unoccupied operation when the space relative humidity rises above set point, the unit shall be placed in dehumidification mode. Cooling shall be maximized and hot gas reheat modulated to maintain space temperature set point. The unit shall remain in dehumidification mode until the relative humidity drops to 5% RH below set point at which time the unit shall return to normal mode. Refer to applicable paragraphs for operation of valves, dampers, and fans.
- I. Outdoor Air Damper (D-1):

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1. Unoccupied: Damper shall be modulated fully closed. The damper end switch shall confirm the damper is closed. If the damper fails to close, an alarm shall be sent to the head end identifying the unit and stating that the outdoor damper failed to close.
 2. Occupied: The damper shall modulate fully open.
 3. Economizer: The damper shall modulate to open inversely with the return air damper (D-2) to maintain above scheduled outdoor air (as sensed by the outdoor air flow measuring station) to maintain leaving air temperature as the first stage of cooling.
- J. Return Air Damper (D-2):
1. Unoccupied: Damper shall be fully open. The damper end switch shall confirm the damper is open. If the damper fails to open, an alarm shall be sent to the head end identifying the unit and stating that the return damper failed to open.
 2. Occupied: The damper shall modulate fully closed.
 3. Economizer: The damper shall modulate to close inversely with the outside air damper (D-1) to maintain leaving air temperature as the first stage of cooling.
- K. Economizer Mode: Whenever outside air enthalpy is less than return air enthalpy and cooling is required, economizer operation shall be enabled.
1. Economizer operation shall be available twenty-four hours per day and shall override unoccupied damper controls.
 2. Economizer mode shall be disabled when outside air temperature exceeds 65 degrees F dry bulb.
- L. Space Temperature: Space temperature shall be sensed using the wall mounted temperature sensor.
- M. Dead band: A five-degree (5°F) dead band shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.
- N. Life Safety: Duct smoke detectors located in the return/exhaust air duct, upon detection of products of combustion from any detector, signal the building fire alarm system and shut down the unit & supply fan. This function shall be manually reset from the unit and shall be so identified on the head-end graphics. An alarm shall also be provided to the BAS head-end.
- O. System Safety: Whenever the supply fan is stopped or airflow ceases for any reason (as sensed by the motor status sensing circuit), the supply fan shall be deactivated and alarm issued to BAS. The outdoor air damper (D-1) shall be closed and return damper (D-2) open. In all modes of operation, commanded position values for all control devices such as dampers shall be readable from the head-end.
- P. Condensate Pan Overflow Prevention: The unit shall monitor float switches in the condensate pan under the evaporator. If the float switch detects the pan is about to overflow and has reached its high limit, the unit shall disable the cooling and issue an alarm to the BAS.
- Q. Filter Change Alarm: The differential pressure across the filters shall be monitored, where if the differential pressure exceeds 1" wg (adjustable), an alarm is issued to BAS.
- 2.12 FAN (Control Method BAS Schedule)

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- A. General: These are general duty fans which operate on a time-of-day schedule. Refer to the Fan Schedule for fan information.
- B. Occupied/Unoccupied:
 - 1. Unoccupied Operation: During unoccupied hours the fan shall be off and the damper shall be closed.
 - 2. Occupied Operation: During occupied hours, the fan shall be on and the damper shall be open.
- C. Start:
 - 1. At the start of occupied operation, the BAS shall open the motorized damper associated with the fan. Once the damper is confirmed open, the BAS shall start the fan. If the damper is interlocked with fan operation, then the BAS shall start the fan.
- D. Stop:
 - 1. At the beginning of unoccupied operation, the BAS shall stop the fan and close the associated damper (or just stop the fan if the damper is interlocked).
- E. Fan failure alarm:
 - 1. If the fan fails to start (as sensed by its current sensing relay) an alarm shall be sent to the head end identifying the fan and stating that it has failed to start.

2.13 FAN (Control Method Line-Voltage Thermostat)

- A. General: These are general duty fans which operate to limit space temperature. Refer to the Fan schedule for information regarding control method.
- B. Occupied/Unoccupied:
 - 1. During unoccupied and occupied operation, the fan shall be enabled. If the space temperature sensor exceeds its adjustable set point (initially 85F), then the intake and backdraft dampers shall be opened and fan shall start. The fan shall operate until space temperature reaches 10F below set point, and the fan shall turn off.
- C. Fan failure alarm:
 - 1. If the fan fails to start (as sensed by its current sensing relay) an alarm shall be sent to the head end identifying the fan and stating that it has failed to start.

2.14 FAN (Control Method BAS Sensor)

- A. General: These are general duty fans which operate to limit space temperature. Refer to the Fan schedule for information regarding control method.
- B. Set points:
 - 1. Space Temperature: 80°F (adj)

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- C. Space Temperature Control: When space temperature (as sensed by wall-mounted temperature sensor) rises above set point, the BAS shall start the fan and open the associated motorized intake damper. When space temperature (as sensed by wall-mounted temperature sensor) falls below set point, the BAS shall disable the fan and close the associated motorized damper.
- D. Fan failure alarm:
 - 1. If the fan fails to start (as sensed by its current sensing relay), an alarm shall be sent to the head end identifying the fan and stating that it has failed to start.

2.15 EMERGENCY GENERATOR POWERING

- A. Provide for provisions for unit operation when the facility loses power and is on emergency (generator) power. Coordinate with electrical the serving of units on emergency power.

2.16 FIRE ALARM MONITORING

- A. The BAS shall monitor a set of dry contacts on the fire alarm system. When the fire alarm system issues an alarm, it shall be forwarded to the BAS head end. Provide a graphic with the alarm status on the head end graphics.

2.17 ROOFTOP EXHAUST FAN FOR VEHICLE SALLYPORT (CO)

- A. Fan controlled by wall mounted temperature sensor (set point 85 degrees F) or CO sensor. CO setpoint is 20 PPM, when the setpoint is reached the fan shall be started and run until the CO concentration falls 10 PPM below setpoint.
- B. Fan failure alarm:
 - 1. If the fan fails to start (as sensed by its current sensing relay) an alarm shall be sent to the head end identifying the fan and stating that it has failed to start.

2.18 DOMESTIC HOT WATER PUMP (TYPICAL EACH CIRCULATING PUMP)

- A. During occupied hours, the BAS shall command the pump on.
- B. During unoccupied hours, the BAS shall command the pump off.
- C. Should the pump fail to run (as sensed by the current sensing relay), an alarm shall be sent to the head end identifying the pump and stating that it has failed.

2.19 HVAC EMERGENCY STOP BUTTON

- A. The BAS shall monitor the HVAC Emergency Stop Button located in the Central Control Room (CR205). If pressed, RTUs and OAUs shall be shut down to cease operation of supply and return air systems.

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- B. After the button is pressed, the system shall stay in the sequence until it is manually reset at the BAS head end through a separate secure password. Provide clear indication on the main graphics screen when this sequence is activated, and provide a manual reset button on graphics screen in large text, where after click to reset, a separate password must be entered.

2.20 DOMESTIC HOT WATER:

- A. The BAS shall monitor the temperature of the domestic hot water systems (temperature of water leaving the thermostatic mixing valve assembly) and shall issue an alarm to the head end if the temperature is more than 10° above or below set point. Alarm shall be disabled during unoccupied time periods and shall be enabled 1hour after occupancy.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

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SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Pre-submittal meeting: The contractor performing work under this section of the specifications shall attend a meeting for the purpose of coordinating with the control system. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the contractor. The contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
 - 2. Valves-Include flow and pressure drop curves/information based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow control valves.
 - 3. Air control devices.
 - 4. Chemical treatment.
 - 5. Hydronic specialties.
- C. Maintenance Data: For hydronic specialties, balancing valves, automatic flow control valves, and special-duty valves to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.

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- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.5 BUILDING AUTOMATION SYSTEM COORDINATION:

- A. If indicated, all wells, valves, taps, dampers, flow stations, etc. furnished under Section "Building Automation System" shall be installed under this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping, components, and installation shall withstand the following minimum working pressure and temperature unless otherwise indicated: 150 psig at 200 degrees F.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K. (underground installations)
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
- E. Copper or Bronze Pressure-Seal Fittings:
 - 1. Manufacturers:
 - a. Elkhart Products Corporation.
 - b. Mueller Industries, Inc.
 - c. NIBCO, Inc.

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- d. Viega, LLC.
- 2. Housing: Copper
- 3. O-Rings and Pipe Stops: EPDM.
- 4. Tools: Manufacturer's special tools.
- 5. Minimum 200 psig working pressure rating at 250°F.

F. Wrought-Copper Unions: ASME B16.22.

2.4 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
 - 1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
 - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. 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.
- G. Solvent Cements for CPVC Piping: ASTM F 493.
- H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

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2.6 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
 - 1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

- B. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- C. Dielectric Unions:
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Matco-Norca.
 - c. Watts Water Technologies, Inc.
 - d. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- D. Dielectric Flanges:
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Matco-Norca.
 - c. Watts Water Technologies, Inc.
 - d. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- E. Dielectric-Flange Insulating Kits:

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1. Available Manufacturers:
 - a. Advance Products and Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

F. Dielectric Nipples:

1. Available Manufacturers:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig at 225 deg F.
 - d. End Connections: Male threaded.
 - e. Lining: Inert and noncorrosive, propylene.

2.8 ROOF PIPING PENETRATIONS

- A. Available Manufacturers:
 1. The Pate Company (Model PHA-2)
 2. Roof Penetration Housings, LLC (Vault Models with Exit Seals)
 3. Roof Products, Inc. (Model RPPC-90).
- B. Provide pipe hood assembly for pipe penetrations through a roof that are not installed within a roof curb. Provide pipe hood assembly for single or multiple pipes to match application.
- C. Pipe hood assembly shall consist of heavy-gauge aluminum construction and removable water-tight top cover, faceplate and 3-sided body for access to interior. Provide separate, fully-welded and insulated aluminum mounting base to isolate hood from galvanized roof curb. Field insulate hood interior and caulk all exposed joints after installation of piping.

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PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC or CPVC plastic pipe and fittings with solvent-welded joints.
 - 1. Exceptions where PVC, CPVC, and other forms of plastic are not permitted:
 - a. Jails.
 - b. Prisons.
 - c. Plenums.
 - d. Locations prohibited by codes or standards.
- B. Miscellaneous: Same materials and joining methods as connecting service.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved in writing on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

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- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and 8" NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- Q. Install all wells, valves, taps, flow stations, etc. furnished under Section "Building Automation System."
- R. Install exterior piping at a uniform grade of 0.2 percent upward in direction of flow. Interior piping may be installed level.
- S. Install condensate drain piping at a minimum uniform slope of 1" in 10'-0" in the direction of flow.
- T. Reduce pipe sizes using concentric reducers, or eccentric reducers installed with level side up.
- U. Provide branch connections with the takeoff coming off the top of the main.
- V. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and as indicated. Install 3/4" diameter by 8" long nipple and ball valve in blowdown connection of strainers 3/4" and larger. Match size of strainer blow-down connection for strainers smaller than 3/4".
- W. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- X. Where piping penetrates a non-fire-resistance-rated floor or floor/ceiling assembly or ceiling membrane of a non-fire-resistance-rated roof/ceiling assembly, provide the following:
 - 1. For noncombustible piping that connects not more than five stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion or with a tested and classified through-penetration firestop system.
 - 2. For piping that connects not more than two stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion.
 - 3. For piping that penetrates a non-rated wall, protect the annular space around the penetrating piping with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

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3.3 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.
 - 3. Damaged Welds: Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
 - 1. 3/4": Maximum span, 5'-0"; minimum rod size, 1/4".
 - 2. 1": Maximum span, 6'-0"; minimum rod size, 1/4".
 - 3. 1 1/2": Maximum span, 8'-0"; minimum rod size, 3/8".
 - 4. 2": Maximum span, 8'-0"; minimum rod size, 3/8".
 - 5. 2 1/2": Maximum span, 9'-0"; minimum rod size, 3/8".
 - 6. 3": Maximum span, 10'-0"; minimum rod size, 3/8".
- C. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- E. Where changes in direction or tees occur, place hangers 1/3 of the maximum allowed spacing distance from the change in direction or tee (i.e. if the maximum span is 12 feet, the hanger

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shall be 4feet from the change in direction or tee). Pipe shall be supported from both sides of a change in direction.

3.5 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during testing.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush system with clean water. Clean strainers.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

END OF SECTION 232113

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SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated for the following:
 - 1. Thermostatic expansion valves.
 - 2. Filter dryers.
 - 3. Strainers.
- B. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.3 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.4 QUALITY ASSURANCE

- A. Welding/Brazing: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."
- B. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for wall penetrations.

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- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.
- F. Some components listed in this section may be factory installed, such as thermostatic mixing valves or service valves.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig.
- B. Thermostatic Expansion Valves: Comply with ARI 750.
 - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Packing and Gaskets: Non-asbestos.
 - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 - 5. Suction Temperature: 40 deg F.
 - 6. Superheat: Adjustable.
 - 7. Reverse-flow option for heat-pump applications.
 - 8. End Connections: Socket, flare, or threaded union.
 - 9. Working Pressure Rating: 450 psig.
- C. Moisture/Liquid Indicators:
 - 1. Body: Forged brass.

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2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow where heat-pump applications are indicated.
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig Insert value.
8. Rated Flow: Match equipment.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. Available Manufacturers:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT

- A. Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install moisture/liquid indicator and filter dryer in each refrigerant circuit.

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3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal suction lines with a uniform slope downward to compressor.
 - 2. Install traps and double risers to entrain oil in vertical runs.
 - 3. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, & packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

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- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of exterior walls and floor slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for HVAC Piping."

3.4 PIPE 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. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20'-0" long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20'-0" or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20'-0" or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

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- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. ½": Maximum span, 60"; minimum rod size, ¼".
 2. 5/8": Maximum span, 60"; minimum rod size, ¼".
 3. 1": Maximum span, 72"; minimum rod size, ¼".
 4. 1 ¼": Maximum span, 96"; minimum rod size, 3/8".
 5. 1 ½": Maximum span, 96"; minimum rod size, 3/8".
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 2. Break vacuum with refrigerant gas, allowing pressure to build up to manufacturer's recommendation.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper performance.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.

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END OF SECTION 232300

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:
1. Seal all longitudinal joints.
 2. Seal all transverse joints.
 3. Seal all penetrations.
- B. Seal Class: A
- C. Test pressure:
1. 3.0" WC for round and flat oval duct.
 2. 6.0" WC for rectangular duct.
 3. Un-tested: NA
- D. Test pressure and maximum leakage for smoke control ductwork:
1. 1.5 times the maximum design pressure and measured leakage not to exceed 5% of design airflow.
- E. Testing: Leak test all ductwork operating at 3.0" WC or greater.
- F. Duct Construction: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- G. Liner Airstream Surfaces: Liner surfaces in contact with the airstream shall comply with ASHRAE 62.1-2007, paragraph 5.5.
- H. Cleanliness: All factory fabricated duct shall be cleaned with a non-toxic, biodegradable cleaner/degreaser and shall be shrink wrapped prior to shipment.
- I. Structural Performance: Smoke removal duct hangers, supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005 and ASCE/SEI 7.

1.3 ABBREVIATIONS

- A. BAS Building Automation System
- B. NRTL Nationally Recognized Testing Laboratory

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- C. SMACNA Sheet Metal and Air Conditioning Contractors' National Association
- D. WC Water Column

1.4 DEFINITIONS:

- A. Duct System: For the purposes of this section "duct system" shall mean all metal supply, return, and exhaust duct and fittings between the air moving device and the space.
- B. Low Pressure: Plus two (2.0) inches WC to minus one (1.0) inches WC
- C. Medium Pressure: More than two (2.0) inches WC to plus ten (10.0) inches WC or more than minus one (1.0) inch to minus ten (10.0) inches WC
- D. High Pressure: More than plus or minus ten (10.0) inches WC.

1.5 SUBMITTALS

- A. Product Data / Documentation: For each of the following:
 - 1. Sheet metal thicknesses.
 - 2. Liners and adhesives.
 - 3. Pre-manufactured ductwork.
 - 4. Sealants and gaskets.
 - 5. VOC content for adhesives and sealants.
 - 6. Seismic-restraint devices.
- B. CAD-generated Shop Drawings:
 - 1. Provide coordination shop drawings with all trades for entire building including kitchen, laundry and water/mechanical rooms. Include
 - 2. Show fabrication and installation details for metal ducts.
 - 3. 1/4" = 1'-0" scale minimum including duct layout indicating sizes and pressure classes for the following areas:
 - a. Areas indicated on the drawings at 1/4" = 1'-0" scale.
 - b. Areas where sections are cut.
 - c. Auditoriums.
 - d. Gymnasiums.
 - e. Commercial kitchens.
 - f. Commercial laundries.
 - g. Finished spaces with exposed ductwork.
 - 1) Exceptions:
 - a) Janitors closets
 - b) Storage Rooms
 - c) Receiving Areas
 - 2) Include:
 - a) Plans, elevations and sections.
 - b) Elevations of top and bottom of ducts.
 - c) Dimensions of main duct runs from building grid lines.
 - 4. 3/4" = 1'-0" scale minimum for the following:

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- a. Hangers and supports, including methods for duct and building attachment, vibration isolation and seismic restraints.
 - b. Duct accessories, including access doors and panels.
 - c. Equipment installation based on approved equipment submittals.
 - d. Penetrations through fire-rated and other partitions.
 - e. Fittings.
 - f. Components.
- C. Submittals during construction:
- 1. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2007, Section 6.4.4.2.2 - "Duct Leakage Tests."
 - 2. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1-2007, Section 7.2.4 - "Ventilation System Start-Up."

1.6 QUALITY ASSURANCE

- A. Provide work in compliance with applicable Building Code requirements.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- C. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- D. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- E. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- F. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- G. ASHRAE/IESNA Compliance: Comply with applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. Mockups (Contractor's option in lieu of 3"=1'-0" details):
 - 1. Before installing duct systems, build mockups. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 2. Three transverse joints.
 - 3. One Reinforced section with 3 reinforcements.
 - 4. One of each type; attachments to other work.
 - 5. Two typical flexible duct or flexible-connector connections.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMMERCIAL KITCHEN GREASE DUCTS

- A. Provide factory-built grease duct or field-built grease duct.
- B. Factory-Built Grease Ducts:
 - 1. Manufacturers:

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- a. Hart & Cooley, Inc. (Commercial Products Group)
 - b. Heat-Fab Inc.
 - c. Metal-Fab, Inc.
 - d. Schebler Co. (The).
 - e. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - f. Van-Packer Co.
2. General: Double-wall, factory-fabricated and -insulated grease duct conforming to the requirements of UL 1978.
- a. Provide hood and fan transitions, pipe supports, guides, fittings, cleanout ports, ports for the introduction of fire suppression and wash-down nozzles, expansion joints, and thimbles for penetration of non-fire rated building members as required to meet applicable building code requirements.
 - b. Provide all components of the grease duct system.
3. Listings:
- a. Listed and labeled UL-1978 for venting air and grease vapors from commercial cooking operations.
4. Rating:
- a. Continuous operation at 500°F.
 - b. Intermittent operation (30 minutes) at 2,000°F.
5. Penetration of rated walls and partitions: Listed to penetrate walls and partitions rated for up to two (2) hours. Fire-stop penetrations in accordance with the manufacturer's instructions. Metal-Fab Model PICPPK fire stop kit or approved equivalent.
6. Listed Clearance to combustibles: 0"
7. Materials:
- a. Inner wall: 0.035" thick type 304 or 316 stainless steel.
 - b. Outer wall: 0.025" thick aluminized steel.
 - 1) Exception: Exposed portions of duct shall be type 304 or type 316 stainless steel finished to match exposed surfaces of grease hood.
 - c. Insulation: 4" high temperature ceramic insulation.
 - d. Mechanical Joints: Integral flanges on adjoining sections of pipe held together with a stainless steel flange band.
 - e. Sealant: Sealed with manufacturer's recommended sealant. Metal-Fab P080 or equivalent.
 - f. Supports and Guides: Anchor with minimum 5/8" diameter FM-Stainless Fasteners, FIX Epoxy Anchoring System or equivalent approved by Local Authority Having Jurisdiction.

C. Field-Built Grease Ducts:

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1. General: Grease ducts severing Type I hoods shall be constructed of single wall, 16-gauge black steel or 18-gauge stainless steel.
2. Joints: Joints, seams, and penetrations of grease ducts shall be made with a continuous, liquid-tight, weld or braze made on the external surface of the duct system.
 - a. Joint Types: Duct joints shall be butt joints, welded flange joints with a maximum flange depth of ½ inch or overlapping duct joints installed to prevent accumulation of grease or interference with gravity drainage. The difference in cross-sectional dimensions of overlapping duct sections shall not exceed ¼ inch. The length of overlap shall not exceed 2 inches.
 - b. Duct-to-hood joints shall be made with continuous internal or external liquid-tight welded or brazed joints. Joints shall be smooth, accessible for inspection, and shall not trap grease.
 - c. Duct-to-fan connection shall be flanged and gasketed at the base of the fan for vertical discharge fans; flanged, gasketed, and bolted to the inlet of the fan for side-inlet utility fans; and flanged, gasketed, and bolted to the inlet and outlet of the fan for inline fans. Gasket and sealing materials shall be rated for continuous duty at a temperature of not less than 1500°F.
3. Grease duct bracing and supports shall be noncombustible securely attached to the structure. Bolts, screws, rivets and other fasteners shall not penetrate duct walls.
4. Grease ducts shall be constructed and installed so that grease cannot collect in any portion of the duct system. The duct shall slope toward the hood or an approved reservoir in accordance with the applicable mechanical code.
5. Grease duct cleanouts and openings shall comply with the requirements in the applicable mechanical code.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-1, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," 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, Third Edition 2005."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 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, Third Edition 2005."

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2.3 LOW PRESSURE SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS – CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on specified static-pressure class unless otherwise indicated.
- B. Snap-Lock Round Pipe
 - 1. Meet SMACNA Class 3 Leakage standards and SMACNA Seal Class A with external, mastic duct sealant. Provide ASTM A653 galvanized steel, 26 gauge, G-60 coating. Product shall meet pressure rating of -1" wg to +2" wg.
 - 2. Available Manufacturers:
 - a. GreenSeam Industries (GreenSeam Plus)
- C. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- D. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Greater than 48": Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter or Flat Oval with a Major Dimension Less than 48".
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter or Flat Oval with a Major Dimension Greater than 48".
- F. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- G. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- H. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90° 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

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"HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

- I. All round duct shall not be less than 26-gauge.

2.4 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS
-CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90° 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, Third Edition 2005." Adjustable elbows are not permitted.
- H. All seam types in Figure 3-2 are acceptable where approved by SMACNA.
- I. All round duct shall not be less than 26-gauge.

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- 2.5 LOW PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS - EXPOSED
- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.
 - B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
 - C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
 - D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
 - E. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." And the following:
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
 - F. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, " Round Duct Longitudinal Seams"
 - G. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.
 - H. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
 - I. Longitudinal seams shall be spiral type.
 - J. All round duct shall not be less than 26-gauge.

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2.6 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS
-EXPOSED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
- E. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." And the following:
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 - 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- F. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, " Round Duct Longitudinal Seams"
- G. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.
- H. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- I. Longitudinal seams shall be spiral type.
- J. All round duct shall not be less than 26-gauge.

2.7 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS (PERFORATED
LINER)

- A. Manufacturers:

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1. Eastern Sheet Metal.
 2. Hamlin Sheet Metal.
 3. Linx Industries - Lindab.
 4. McGill AirFlow LLC.
 5. MKT Metal Manufacturing
 6. Semco, Inc.
 7. Sheet Metal Connectors, Inc.
 8. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005, Third Edition 2005."
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90° 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, Third Edition 2005."
- G. Inner Duct: Minimum 24-gauge perforated galvanized sheet metal steel having 3/32-inch diameter perforations with overall open area of 23 percent.
- H. 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. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 2. Coat insulation with antimicrobial coating.
 3. Cover insulation with polyester or Mylar film complying with UL 181, Class 1.
- I. All round duct shall not be less than 26-gauge.

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2.8 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" 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.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316, cold rolled, annealed, sheet. Exposed surface finish shall be No. 4.
- 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.
- G. 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.
- H. 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.

2.9 DUCT LINER

- A. For double wall duct: Not required. All other duct: Provide where indicated.
- B. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 3. For supply ductwork, provide antimicrobial, erosion-resistant coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

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4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- C. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B. Foam shall contain or be coated with EPA-approved or EPA-registered antimicrobial additive or paint.
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 2. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- D. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- E. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

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2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- G. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.10 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723.
1. Materials: Certified by a NRTL.
- B. Tape sealing systems are not permitted.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 10. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 12. Service: Indoor or outdoor.
 13. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

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- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.11 HANGERS AND SUPPORTS

- A. Hanger Rods: Galvanized, all-thread.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. 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.

2.12 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. TOLCO; a brand of NIBCO INC.
 - 7. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

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1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
 - C. Channel Support System: Shop-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
 - D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
 - E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
- 2.13 RESIDENTIAL DRYER VENTING ACCESSORIES
- A. Dryer Vent Wall Box: In-wall receptacle to house dryer transition duct.
 1. In-O-Vate Technologies, Inc. – Dryerbox
 2. American Aldes – Dryer vent box
 3. Lambro Industries, Inc. – Dryer wall box
 4. Construction Solutions, LLC. – Dryer vent box.
 5. Approved equal.
 - B. Dryer Transition Duct: Provide UL 2158A-listed product.
 1. In-O-Vate Technologies, Inc.
 2. QuietFlex Manufacturing Co, LP
 3. Lambro Industries, Inc.
 4. Flexible Technologies, Inc. – Thermaflex
 5. Approved equal.
 - C. Dryer Vent Long Radius Elbows:
 1. In-O-Vate Technologies, Inc. – Dryer-Ell
 2. Approved equal for long radius elbows for dryer vent.
 - D. Wall Vent: Galvanized steel body with backdraft damper. Paint or provide color per architect.
 1. In-O-Vate Technologies, Inc. – Dryer Wall Vent
 2. American Aldes – Standard Dryer Wall Hood
 3. Approved equal for dryer vent terminations through exterior walls.
 - E. Roof Vent: Galvanized steel body with backdraft damper.
 1. In-O-Vate Technologies, Inc. – Dryer Jack
 2. American Aldes - Dryer Roof Cap
 3. Approved equal for dryer vent terminations through roofs.

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PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. 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 by Architect in writing.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically or horizontally, and parallel or perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Maintain clearances for equipment maintenance.
- G. Install ducts with a clearance of 1 inch, plus allowance for installation of insulation at specified thickness.
- H. Do not route ducts through transformer vaults, electrical equipment rooms, elevator equipment rooms or electrical 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. Provide fire dampers where ducts pass through fire-rated interior partitions, fire-rated exterior walls, fire-rated floor assemblies, or fire-rated shaft enclosures.
- K. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 PROTECTION OF WALL AND FLOOR PENETRATIONS OF NON-RATED ASSEMBLIES

- A. Where ducts penetrate non-fire-resistance-rated wall or floor assemblies, protect the penetration with one of the following:
 - 1. For a duct that connects not more than two stories vertically, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion.
 - 2. For a duct that connects not more than three stories, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion and a fire damper at each floor line.
 - 3. For ducts that penetrate a smoke partition without a smoke damper, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

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4. For ducts that penetrate a non-rated wall, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.3 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. Do not weld or grind lined ductwork.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of duct, fittings, hangers, supports, accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 INSTALLATION OF COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed. Ducts shall be considered concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides.
 1. The Contractor shall provide the necessary equipment and perform a grease duct leakage test. A light test shall be performed to determine that all welded and brazed joints are liquid tight. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested.
 2. The lamp shall be open to emit light equally in all directions perpendicular to the duct walls. A test shall be performed for the entire duct system, including the hood-to-duct connection.
 3. The duct work shall be permitted to be tested in sections, provided every joint is tested. For listed, factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds.
- B. Grease ducts shall be constructed and installed so that grease cannot collect in any portion thereof, and the system shall slope not less than one-fourth unit vertical in 12 units horizontal toward the hood or toward a grease reservoir designed and installed in accordance with the mechanical code. Where horizontal ducts exceed 75 feet in length, the slope shall be not less than one unit vertical in 12 units horizontal.
- C. Duct Cleanouts and Openings: Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings.
 1. Cleanouts and openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the duct.
 2. Cleanout doors shall be installed liquid tight.
 3. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the duct.

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4. Gasket and sealing materials shall be rated for not less than 1500°F.
 5. Listed door assemblies shall be installed in accordance with the manufacturer's instructions.
- D. Horizontal Cleanouts: Cleanouts serving horizontal sections of grease ducts shall:
1. Be spaced not more than 20 feet apart.
 2. Be located not more than 10 feet from changes in direction that are greater than 45 degrees.
 3. Not be closer than 1 inch from the edges of the duct.
 4. Not be located on the bottom of the duct.
 5. Have opening dimensions of not less than 12 inches by 12 inches. Where such dimensions preclude installation, the opening shall be not less than 12 inches on one side and shall be large enough to provide access for cleaning and maintenance.
 6. Shall be located at grease reservoirs.
- E. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- F. Install factory-built grease duct in accordance with manufacturer's instructions.
- G. Duct Termination:
1. Termination above the roof: Exhaust outlets that terminate above the roof shall have the discharge opening located not less than 40 inches above the roof surface.
 2. Termination through an exterior wall: Exhaust outlets shall be permitted to terminate through exterior walls where the smoke, grease, gases, vapors and odors in the discharge from such terminations do not create a public nuisance or a fire hazard. Such terminations shall not be located where protected openings are required by the building code. Other exterior openings shall not be located within 3 feet of such terminations.
 3. Termination location: Exhaust outlets shall be located not less than 10 feet horizontally from parts of the same or contiguous buildings, adjacent buildings and adjacent property lines and shall be located not less than 10 feet above the adjoining grade level. Exhaust outlets shall be located not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building.

3.5 DUCT SEALING

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:
1. Seal all longitudinal joints.
 2. Seal all transverse joints.
 3. Seal all penetrations.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Unless indicated otherwise, provide concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

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1. Where practical, install concrete inserts before placing concrete.
 2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.
 3. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," 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 channel supports.
- E. Support vertical ducts with channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor or at a maximum interval of 18 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Design hangers and braces to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7 and brace changes of direction longer than 12 feet.
- 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 ducts that are suspended with vibration isolators.
- E. 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.
- F. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the 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, and 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.

3.8 CONNECTIONS

- A. Make connections to equipment with flexible connectors.

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- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" for branch, outlet, inlet, and terminal unit connections unless otherwise indicated.

3.9 PAINTING

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

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Visually inspect, for proper seal application, all ductwork not tested prior to insulation application. Prepare inspection report.
- C. Smoke Control Duct Air Leakage Test – Test all smoke control ductwork.
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
 - 2. Test ducts. Disassemble, reassemble, reseal, and retest until 5% leakage of design airflow or less is achieved.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures 1.5 times the maximum design pressure of system or section being tested.
 - 6. Provide seven-day advanced notice to Architect and Owner for leakage testing.
- D. Leakage Test. Test ducts with operational pressures greater than 3" WC.
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
 - 2. Test ducts, disassemble, reassemble, reseal, and retest until leakage class 3 (as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005) is achieved.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested.
 - 6. Give seven days' advance notice to Architect and Owner for testing.
- E. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present. If visible contaminants are present, proceed to sub-paragraph 2 below. If not, no further cleaning shall be required.
 - 2. Test sections of metal duct systems, up to one location per ten thousand (10,000) square feet of building area, or a minimum of two (2) per system, whichever is greater, chosen by the Owner's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm. Cut

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hole in duct and install access door at each location selected. Size shall be as indicated in Division 23 Section "Air Duct Accessories."

3. Duct system shall be considered dirty and in need of cleaning if any test location does not pass the cleanliness test. Cleaning shall be performed in accordance with this specification.

- F. Prepare and submit test and inspection reports.

3.11 DUCT CLEANING

- A. Clean new duct systems before testing, adjusting, and balancing.
- B. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" dated 2000, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3.11.

3.12 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.13 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 1. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 2. Concealed: Carbon-steel sheet.
 3. Welded seams and joints.
 4. Pressure Class: Negative – match or exceed fan static pressure.
 5. Seal: Welded seams, joints, and penetrations.
 6. SMACNA Leakage Class: 3.
- C. Ducts Connected to Dishwasher Hoods:
 1. Type 304, stainless-steel sheet.
 2. Exposed to View: No. 4 finish.
 3. Concealed: No. 2D finish.
 4. Welded seams and flanged joints with watertight EPDM gaskets.
 5. Negative – match or exceed fan static pressure.
 6. Seal: Welded seams, joints, and penetrations.
 7. SMACNA Leakage Class: 3.
- D. Ducts Connected Serving Locker Rooms, Shower Rooms, and Team Rooms:
 1. Aluminum sheet.
 2. Exposed to View: Bright finish.
 3. Concealed: Mill finish.
- E. Double-Wall Duct Interstitial Insulation (where indicated):
 1. Supply Air Ducts: 1" thickness.

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- F. Rectangular Duct Liner Thickness (where indicated):
 - 1. Supply Air Ducts: 1-1/2" thickness and minimum R=5.0.
- G. Transfer Duct Liner (where indicated): 1" thickness.
- H. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-2, "Rectangular Elbows."
 - a. Velocity less than 1500 fpm or lower:
 - 1) Radius Type RE 1. Centerline radius = $3W/2$.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 3) Transfer ducts indicated with mitered elbows do not require turning vanes.
 - b. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 3. Centerline radius = $3w/2$ and three vanes.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-4, "Round Duct Elbows."
 - a. Minimum centerline radius-to-diameter ratio shall be 1.5 with a maximum of 5 Elbow Segments. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 3-1, "Mitered Elbows." Elbows with less than a 90 degree change of direction shall have segments per Table 3-1 in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005".
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, segmented, spiral or pleated. Adjustable elbows not acceptable.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, segmented, or spiral.
 - 3. Flat Oval Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-7, "Flat Oval Ducts" for elbows.
- I. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical or bell mouth. No flanged or spin-in fittings permitted.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-6, "Conical Tees."
 - a. Conical fitting.
 - b. Conical saddle taps.
 - c. No 90 degree taps or 90 degree saddle taps permitted.

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J. Divided Flow Branches:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible, Third Edition 2005, "Figure 4-5 Divided Flow Branches."

3.14 Duct Pressure Classes:

- A. Supply ducts from rooftop units to terminal units: 3 inches WC.
- B. Supply ducts from terminal units to air terminals: 1 inch WC.
- C. Return ducts: 1 inch WC.
- D. Exhaust ducts: 2 inch WC.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Radius forming braces
 - 2. Volume dampers.
 - 3. Smoke control manual volume dampers.
 - 4. Smoke control dampers
 - 5. Fire dampers.
 - 6. Smoke dampers.
 - 7. Combination fire-smoke dampers.
 - 8. Turning vanes.
 - 9. Remote damper operators.
 - 10. Duct-mounted access doors.
 - 11. Duct access panel assemblies.
 - 12. Flexible connectors.
 - 13. Flexible ducts.
 - 14. Duct security bars.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.
- C. Comply with SMACNA standards for manual airflow regulators (dampers).

1.4 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed. Minimum 1 of each type used.

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PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable duct installation methods unless otherwise indicated.
- C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a NO 2 finish for concealed ducts and NO 4 finish for exposed ducts.
- E. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- H. 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; compatible materials for aluminum and stainless-steel ducts.

2.2 RADIUS FORMING BRACES

- A. Available manufacturers:
 - 1. Titus, FlexRight (Basis of Design)
 - 2. Flexible Technologies, Inc., Thermaflex Division, FlexFlow
 - 3. Hart & Cooley, Smart Flow Elbow
- B. General: UL-2043 listed or NRTL approved product constructed of metal or plastic manufactured for use with flexible duct to form a kink free elbow using the flexible duct. Any flexible duct used in forming the elbow shall be included in the maximum permitted length. Resulting flexible duct shall comply with SMACNA HVAC Duct Construction Standards.
- C. Duct Size: 6" through 16" in diameter.
- D. Inside (Bend) Radius: Minimum of one duct diameter along centerline.
- E. Attachments: Plastic zip ties or stainless steel worm gear clamps.
- F. Support to Overhead: Shall meet SMACNA requirements. Use of specified attachments for support shall not be permitted.

2.3 MANUAL VOLUME DAMPERS

- A. Damper Hardware:

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1. Locking Hardware Component: Everlock damper handle by Rossi.
 - a. Bracket: Cold Rolled Steel (ASTM A-1008), 18-gauge nominal thickness of 0.0478 with tolerance range of 0.0438 to 0.0518. Single cut and formed bracket for use with 1.5" or 2.0" insulation wrapping or any other such stand-off applications. Finished with a white Chromate plating process which provides durable corrosion resistance. Auto Planting ASTM B-633 Type II (white) class FE/ZN8 or SC2 Thickness of 0.0003.
 - b. Handle and Thumb Trigger: Polyamide 66 (PA66), Flame Retardant, Glass Reinforced, "Zytel," by Dupont.
 - c. Compression Spring: Stainless Steel Type 302-OD 0.25 wire 0.026 free length of 7/8" (0.875").
 - d. Retaining Spring: Ext. Self-Lock TX-75ST-ZF Carbon Steel SAE 1074 with Zink Bright Plating. C-Scale Rockwell Hardness 47 to 51.
- B. Steel, Manual Volume Dampers:
 1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen Manufacturing.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries.
 - g. PCI Industries - Pottorff
 - h. Ruskin Company.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, 0.094-inch thick galvanized or 0.05-inch stainless-steel, match duct material.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized or stainless-steel channels, match duct material.
 6. Blade Axles: Galvanized steel or stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.
 7. Bearings:

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- a. Molded synthetic. Provide bearing at both duct wall penetrations.
 8. Tie Bars and Brackets: Galvanized steel.
 - C. Aluminum, Manual Volume Dampers:
 1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen Manufacturing.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries.
 - g. PCI Industries - Pottorff
 - h. Ruskin Company.
 2. Standard leakage rating, with linkage and operator outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped aluminum channels for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll Formed or Extruded Aluminum.
 - e. Blade Axles: Galvanized steel or Stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.
 6. Bearings:
 - a. Molded synthetic. Provide bearing at both duct wall penetrations.
 7. Tie Bars and Brackets: Aluminum.
 - D. Damper Hardware:
 1. Zinc-plated, die-cast manual quadrant kit with dial and handle made of zinc plated steel, and a hexagon lock nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform or stand-off for insulated duct mounting.
- 2.4 SMOKE CONTROL MANUAL VOLUME DAMPERS
- A. Steel, Manual Volume Dampers:
 1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. Greenheck Fan Corporation.

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- e. McGill AirFlow LLC.
 - f. METALAIRE, Inc.
 - g. Ruskin Company.
 - h. Vent Products Company, Inc.
 2. Low leakage rating, with linkage outside airstream, leakage rating of 3 cfm/sf @ 1" wg or less.
 3. Suitable for air velocities up to 4000 fpm and pressures up to 10" wg differential.
 4. Suitable for horizontal or vertical applications.
 5. Temperature Rating: 250°F.
 6. Frames:
 - a. Hat-shaped, galvanized or stainless-steel channels, match duct material.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 7. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized or stainless-steel channels, match duct material.
 - e. Blade Axles: Galvanized steel or Stainless steel.
 8. Bearings:
 - a. Bronze or 304SS.
 - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
 9. Tie Bars and Brackets: Galvanized steel.
- B. Damper Hardware:
1. Zinc-plated, die-cast quadrant with dial and handle made of zinc plated steel, and a hexagon lock nut and locking washer.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 SMOKE CONTROL DAMPERS

- A. Manufacturers:
1. Johnson Controls
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation. (Basis of design, provide model SMD-301)
 4. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555S by a NRTL.
- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 3000 FPM velocity.
- D. General Requirements: Label according to UL 555S by a NRTL.
- E. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- G. Blade edge seals: Silicone rubber.

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- H. Blade linkage: Out of air stream.
- I. Leakage: Class I.
- J. Mounting Sleeve: Factory-installed galvanized sheet steel; length to suit wall or floor application.
- K. Damper Motor: Two-position.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
 - 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. 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 0 degrees F.
- M. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Damper mounted momentary test switch.

2.6 CURTAIN TYPE FIRE DAMPERS (1½ HOUR)

- A. Manufacturers:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.
- E. Fire Rating: 1½ hours.
- F. Frame: Curtain type with blades inside airstream unless otherwise indicated; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.

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- 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.
- J. Horizontal Dampers: Include stainless-steel closure spring.
- K. Fusible Link: Replaceable, 165 deg F rated.
- L. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing

2.7 MULTI BLADE FIRE DAMPERS (1½ HOURS)

- A. Manufacturers:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 4000 FPM.
- E. Fire Rating: 1½ hours.
- F. Frame: Multiple-blade type; fabricated of galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Blades: Damper blades shall be galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- J. Blade Stops: Locate blade stops at top and bottom of damper frame. They shall occupy no more than ½" of the damper opening area.
- K. Bearings: Axle bearings shall be sintered bronze.
- L. Horizontal Dampers: Include stainless-steel closure spring.
- M. Fusible Link: Replaceable, 165 deg F rated.
- N. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

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2.8 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Johnson Controls
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation. (Basis of design, provide model SMD-301)
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. General Requirements: Rated and labeled according to UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 3000 FPM velocity.
- D. Smoke Detector: Provide factory-mounted and -wired smoke detector with smoke damper or provide field-mounted smoke detector installed within five feet of damper. Detector shall be a listed and labeled. Provide normally open contacts for monitoring by the fire alarm system.
 - 1. Minimum Velocity: Zero feet per minute.
 - 2. Maximum Velocity: Three thousand feet per minute minimum.
- E. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- G. Blade edge seals: Silicone rubber.
- H. Blade linkage: Out of air stream.
- I. Leakage: Class II.
- J. Mounting Sleeve: Factory-installed galvanized sheet steel; length to suit wall or floor application.
- K. Damper Motor: Two-position.
- L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
 - 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. 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 0 degrees F.
- M. Accessories:

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1. Auxiliary switches for position indication.
2. Damper mounted momentary test switch.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
1. Johnson Controls
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation. (Basis of design, provide model FSD-331)
 4. Nailor Industries, Inc.
 5. PCI Industries - Pottorff
 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by a NRTL.
- C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 2000 FPM velocity.
- D. Fire Rating: 3 hours or as indicated.
- E. Smoke Detector: Provide factory-mounted and -wired smoke detector with smoke damper or provide field-mounted smoke detector installed within five feet of damper. Detector shall be a listed and labeled. Provide normally open contacts for monitoring by the fire alarm system.
1. Minimum Velocity: Zero feet per minute.
 2. Maximum Velocity: Three thousand feet per minute minimum.
- F. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed and rated. Provide damper position indicator to indicate open & closed positions.
- H. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- I. Bearings: Sintered bronze.
- J. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.
- K. Blade edge seals: Silicone rubber.
- L. Blade linkage: Out of air stream.
- M. Leakage: Class II.
- N. Mounting Sleeve: Factory installed galvanized sheet steel; length to suit wall or floor.
- O. Damper Motors: Two-position.
- P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.

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3. Spring-Return Motors: Equip with an integral spiral-spring mechanism. 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.
4. Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Provide motors with internal heaters to permit normal operation at 0 degrees F.

Q. Accessories:

1. Auxiliary switches for position indication.
2. Damper mounted momentary test switch.

2.10 FLANGE CONNECTORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Match connecting ductwork.

D. Gauge: 18, 20, or 24 as recommended by manufacturer or match connecting ductwork.

2.11 MANUFACTURED TURNING VANES

A. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 REMOTE DAMPER OPERATORS

A. Manufacturers:

1. Metropolitan Air Technology.
2. PCI Industries – Pottorff.
3. Ruskin Company.
4. Ventfabrics, Inc.
5. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Operator Mounting Location: As indicated. If not indicated;

1. In airstream terminating at face of diffuser.

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2. Outside airstream terminating at round ceiling cup.
3. If multiple diffusers are affected, then in nearest diffuser.

2.13 DUCT-MOUNTED ACCESS DOORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. Kees
5. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. 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.

2.14 DUCT ACCESS PANEL ASSEMBLIES

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.
4. Selkirk Metalbestos

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel. Match duct material.

D. Fasteners: Carbon or stainless steel. Match duct material. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

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2.15 FLEXIBLE CONNECTORS

- A. Do not use on smoke control/management fans. Install on all other fans and fan equipped units even when provided with internal isolation.
- B. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corporation.
 - 3. Ventfabrics, Inc.
 - 4. Hart & Cooley, Inc.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Connector: Factory fabricated with a fabric strip 3½ to 4½ inches wide attached to 2 strips of 2½ to 4½ inches wide, 23 to 25 gauge “0.0269 to .0209 inch thick” galvanized sheet steel, stainless sheet steel, or aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double-coated with neoprene.
 - 1. Minimum Weight: 26 oz/sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- G. Outdoor System, Flexible Connector Fabric: Glass fabric double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz/sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- H. Thrust Limiters:
 - 1. Field fabricated cable restraints on equipment producing greater than 4.0” WC of positive pressure.
 - 2. Field fabricated cable restraints as detailed. If not detailed; Provide restraint consisting of a 1/16 inch diameter vinyl coated steel cable at 24” maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, ½” of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle to duct and shall be routed through a 3/16” diameter hole in the bracket offset approximately 1” from duct.
 - 3. Direction of connector movement: Parallel with airflow, perpendicular to connector.

2.16 FLEXIBLE AIR DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc. (Basis of design, Provide Type 1M)
 - 2. Thermaflex
 - 3. Hart & Cooley, Inc.
- B. Provide bead on connecting duct for sizes greater than 12” in diameter.

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- C. Maximum Length: 6'-0" unless noted otherwise.
- D. Insulated, Flexible Duct: UL 181, Class 1 air duct with vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch WC positive and 1.0-inch WC negative.
 - 2. Maximum Air Velocity: 5000 fpm.
 - 3. Vapor Barrier Permeance: 0.05 perm
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
 - 5. Insulation R-value: 6.0
- E. Flexible Duct Connection Accessories:
 - 1. Low pressure (Not up stream of terminal units):
 - a. Clamps: Nylon strap in sizes 3 through 20", to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: No
 - d. Tape: Yes
 - 2. Medium pressure (Up stream of terminal units):
 - a. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with worm-gear action in sizes 3 through 20 inches, to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: Yes
 - d. Tape: Yes

2.17 DUCT SECURITY BARS

- A. Manufacturers:
 - 1. Keys
 - 2. Price Industries.
 - 3. United Sheet Metal
 - 4. Field or Shop-Fabricated
- B. Description: Factory, shop or field-fabricated and field-installed duct security bars rated for "Maximum Security".
- C. Configuration:
 - 1. Frame: 2¼" by 3/8" inches minimum steel bar.
 - 2. Sleeve: 3/16-inch, continuously welded steel frames with 2¼"x2¼"x3/8" angle frame factory welded to 1 end and furnished loose for field welding on other end. To be welded or bolted in place, one side only. Duct connections as indicated.
 - 3. Horizontal Bars: 2¼" by 3/8" minimum tool resistant steel conforming to ASTM A627-95.
 - 4. Horizontal Bar spacing: 12" OC maximum.
 - 5. Vertical Bars: 7/8" diameter minimum, ribbed on opposite sides, tool resistant steel conforming to ASTM A627-95.
 - 6. Vertical Bar Spacing: 5" OC maximum.
 - 7. Where duct security bars are to be installed within the same penetration/ opening as a life safety damper, provide the security bars in the life safety damper sleeve by the life safety damper manufacturer. The damper with security bars shall be a UL listed

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assembly. Life Safety dampers include fire dampers, smoke dampers, and fire-smoke dampers.

8. Where duct security bars are to be installed in roof penetrations/ openings, the security bars shall be coordinated and integrated with the roof curbs.

2.18 ROOFTOP DUCT SUPPORTS

- A. General Requirements: Field-fabricated assemblies made of corrosion-resistant components to support roof-mounted ductwork.
 1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - i. Rooftop Support Systems – Eberl Iron Works, Inc.
 2. Provide duct supports for duct on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface.

2.19 ACCESSORY HARDWARE

- A. Temporary Test Holes: Drilled in duct as required.
- B. Permanent Test Holes: Cast iron, or cast aluminum, to suit adjacent material, including cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit wall + insulation thickness.
- C. Adhesives: High strength, quick setting, waterproof, and resistant to 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."
- 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. Radius Forming Braces:
 1. Connect flexible ducts to diffusers using a radius forming brace or rigid elbow. If using radius forming brace, deduct four duct diameters from the indicated maximum flexible duct length.
- D. Volume Dampers:

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1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Locate at least two duct diameters from fittings and as far as possible from air outlets.
 2. 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.
 3. Set dampers to fully open position before testing, adjusting, and balancing.
 - a. Install steel volume dampers in steel ducts.
 - b. Install aluminum volume dampers in aluminum and stainless steel ducts.
- E. Install backdraft dampers at inlet of exhaust fans, exhaust ducts as close as possible to louver inlets, and where indicated.
- F. Install fire and smoke dampers where indicated according to UL listing and manufacturer's written instructions.
- G. Connect ducts to duct silencers with flexible duct connectors.
- H. Turning Vanes:
1. Install turning vanes in all duct elbows larger than 12" in height or width.
 2. Exceptions:
 - a. Where prohibited by the applicable code, laws, ordinances or local requirements.
 - b. Where specifically eliminated by Contract.
- I. Provide remote damper operator where manual volume dampers are indicated above inaccessible ceilings.
- J. Duct-Mounted Access Doors:
1. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - a. On both sides of duct coils.
 - b. Upstream or downstream of duct filters.
 - c. At outdoor air intakes and mixed air plenums.
 - d. Downstream of control dampers and backdraft dampers.
 - e. Adjacent to fire or smoke dampers to allow reset and reinstallation of fusible links. Access doors for fire or smoke dampers having fusible links shall be pressure relief access doors and shall have outward operation for access doors installed upstream of dampers and inward operation for access doors installed downstream of dampers.
 - f. Upstream or downstream of duct silencers.
 - g. At control devices requiring inspection.
 - h. Elsewhere as indicated.
 2. Install access doors with swing against duct static pressure except at fire, smoke, and combination fire and smoke dampers.
 3. Access Door Size: Largest of the following permitted by duct dimensions:
 - a. One-Hand or Inspection Access: 8 by 5 inches.
 - b. Two-Hand Access: 12 by 6 inches.
 - c. Head and Hand Access: 18 by 10 inches.
 - d. Head and Shoulders Access: 21 by 14 inches.
 - e. Body Access: 25 by 14 inches.

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- f. Body plus Ladder Access: 25 by 17 inches.
 - 4. Label access doors to indicate purpose in accordance with Section 230553 "Identification for HVAC Piping and Equipment."
 - K. Flexible Connectors
 - 1. Install flexible connectors to connect ducts to equipment- except smoke control/management equipment.
 - 2. Where required, install thrust limiters at all flexible connectors consisting of a 1/16-inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, 1/2" of movement in the flexible connection is preserved. If flanges are not used, provide steel, stainless steel, or aluminum angles for attaching cables. Match angle material to duct material. Cables shall attach to screw or fastener holding angle and shall be routed through a 3/16" diameter hole in the angle offset approximately 1" from duct.
 - L. Connect flexible ducts to metal ducts as follows:
 - 1. Low pressure (Not upstream of terminal units):
 - a. Clamps: Install in accordance with manufacturer's recommendations.
 - b. Tape: Install in accordance with manufacturer's recommendations.
 - c. Cable Ties (18 lb. strength): Install in accordance with manufacturer's recommendations.
 - M. Flexible Ducts
 - 1. Install flexible duct fully extended with no more than 1/2" compression or sag. Do not provide excess length for future relocation of components. Bends shall equal or exceed one duct diameter bend radius based on the inside duct diameter (no sharp corners or kinks). Tape and mastic for sealing flexible duct to metal fittings shall be listed and labeled to UL Standard 181B. Hanging straps, if used, shall include a saddle to avoid crimping the duct. For ducts 12 inches and smaller in diameter, provide a 3" wide saddle. For ducts larger than 12 inches in diameter, provide a 5" wide saddle.
 - 2. Connect supply ceiling diffusers and return grilles to low pressure supply and/or return ductwork where indicated on drawings with five feet maximum length of flexible duct. Provide a radius forming elbow to support flexible duct at diffuser connection unless noted otherwise. Flexible duct not permitted on exhaust systems.
 - N. Install duct security bars where indicated. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch diameter steel bars, 6 inches on center in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2 x 2-1/2 x 1/4-inch steel angle to four sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-inch x 12-inch hinged access panel with cam lock in duct in each side of sleeve.
 - O. Install rooftop duct supports for all roof-mounted ductwork.
- 3.2 TESTING AND BALANCING
- A. Install permanent test holes at fan inlets and outlets within 6 inches of fan, where indicated, and where necessary for testing and balancing. Test holes not required at outlet of roof-mounted fans.

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- B. Install temporary test hole plugs in temporary test holes. Repair insulation at temporary test holes.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement without interference.
2. Inspect access doors. Verify that door can be opened and closed. Verify fire damper, and combination fire and smoke damper fusible links can be reset and changed. Verify fire damper, and combination fire and smoke damper doors open in the direction of air pressure (out on supply ducts and in on return and exhaust ducts).
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement, verify non-interference, and verify that the proper heat-response device is installed.
4. Inspect elbows for turning vanes. Verify they are installed where required.
5. Inspect turning vanes using access doors for proper and secure installation.
6. Operate remote damper operators prior to ceiling installation to verify full range of movement of operator and damper. Verify no interference with damper movement.

END OF SECTION 233300

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's technical data for each ventilator including rated capacities, dimensions, required clearances, operating characteristics, mounting requirements, and furnished specialties and accessories. Provide power and control wiring diagrams. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs with required slope and dimensions. Indicate shimming if required.
 - 7. Security fasteners.
 - 8. Fan speed controllers.
- B. Operation and Maintenance Data: For ventilators to include in emergency, operation, and maintenance manuals.

1.3 TOOLS

- A. Four (4) complete tools (all hardware) required to remove and reinstall security fasteners.
- B. Specifications, including size, of tool required to remove and reinstall security fasteners.
- C. The name and address of three local tool suppliers where tools may be obtained.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for grease (kitchen) hood exhaust shall also comply with UL 762.

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1.5 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven fan. Mark belt set with fan ID and turn over to owner's representative.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATOR(S) (DOWNBLAST)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
- B. Housing: Removable, spun-aluminum dome top and outlet baffle, or extruded-aluminum, rectangular top to direct discharge air downward.
- C. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.
- D. Hinged Sub-Base: Galvanized steel hinged arrangement permitting service and maintenance.
- E. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.
- F. Belt Drives (where indicated in Fan Schedule): Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower.
 - 2. Provide resilient mounting to housing.
 - 3. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 4. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 5. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 6. Fan and motor isolated from exhaust airstream
 - 7. Belt(s): Provide grip notch belt(s). Provide belt tensioner.
 - 8. Motors and drives:
 - a. Mount on vibration isolators.

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- b. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
- c. Make readily accessible for maintenance.

G. Electrically-Commutated Motor (where direct drive indicated in Fan Schedule):

- 1. Motor enclosure: Open type.
- 2. Motor shall be DC electronic commutation type motor (ECM).
- 3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
- 4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
- 5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

H. Overload (Running) Protection:

- 1. Provide motor overload protection as a requirement of this section.
- 2. Provide motor overload protection as recommended by the manufacturer
- 3. Comply with the Section 230513 "Motors for HVAC Equipment"

I. Wind-band: Join to curb-cap with leak-proof continuously welded seam.

J. Accessories:

- 1. Provide disconnect switch.
- 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
- 3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
- 4. Provide roof curb. Refer to Roof Curb Paragraph below.
- 5. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"

2.2 CENTRIFUGAL ROOF VENTILATORS (UPBLAST)

A. Manufacturers:

- 1. Acme Engineering & Manufacturing Corporation.
- 2. Twin City Fan & Blower.
- 3. Greenheck Fan Corporation.
- 4. Loren Cook Company.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle or extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.

- 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- 2. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.

C. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.

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D. Belt Drives (where indicated in Fan Schedule): Comply with the following:

1. Provide drives sized for a minimum of 150% of driven horsepower.
2. Provide resilient mounting to housing.
3. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
4. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
5. Pulleys: Cast-iron, adjustable-pitch motor pulley.
6. Fan and motor isolated from exhaust airstream
7. Belt(s): Provide grip notch belt(s). Provide belt tensioner.
8. Motors and drives:
 - a. Mount on vibration isolators.
 - b. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - c. Make readily accessible for maintenance.

E. Electrically Commutated Motor (where direct drive indicated in Fan Schedule):

1. Motor enclosure: Open type.
2. Motor shall be DC electronic commutation type motor (ECM).
3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

F. Overload (Running) Protection:

1. Provide motor overload protection as a requirement of this section.
2. Provide motor overload protection as recommended by the manufacturer
3. Comply with the Section 230513 "Motors for HVAC Equipment"

G. Wind-band: Join to curb-cap with leak-proof continuously welded seam.

H. Accessories:

1. Provide disconnect switch.
2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
4. Provide roof curb. Refer to Roof Curb paragraph below.
5. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"

2.3 CENTRIFUGAL DISHWASHER ROOF VENTILATOR(S) (UPBLAST)

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. Twin City Fan & Blower.
3. Greenheck Fan Corporation.

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4. Loren Cook Company.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle or extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- C. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone welded solid to Base.
1. Hinged Subbase: Factory installed galvanized-steel hinged arrangement permitting service and maintenance. Include restraints to hold fan above roof and to prevent fan from hitting curb, or curb cant, when opened.
 2. Provide flexible electrical cable, with slack required, inside housing to permit use of hinged subbase for inspection and cleaning
- D. Fan Wheels: Aluminum hub and wheel statically and dynamically balanced with backward-inclined blades matched to inlet cone and with a non-stick or Teflon coating.
- E. Belt Drives (where indicated in Fan Schedule): Comply with the following:
1. Provide drives sized for a minimum of 150% of driven horsepower.
 2. Provide resilient mounting to housing.
 3. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 4. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 5. Provide motor isolated from ducted airstream.
 6. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 7. Fan Shaft:
 - a. Provide turned, ground, and polished steel shaft.
 - b. Key shaft to fan wheel.
- F. Electrically Commutated Motor (where direct drive indicated in Fan Schedule):
1. Motor enclosure: Open type.
 2. Motor shall be DC electronic commutation type motor (ECM).
 3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
 4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
 5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

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G. Overload (Running) Protection:

1. Provide motor overload protection as a requirement of this section.
2. Provide motor overload protection as recommended by the manufacturer
3. Comply with the Section 230513 "Motors for HVAC Equipment"

H. Accessories:

1. Provide disconnect switch.
2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
4. Dishwasher Fan Curb: Terminate exhaust duct a minimum of 24" above finished roof surface. Provide required curb height.
5. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"

2.4 CENTRIFUGAL GREASE (KITCHEN) ROOF VENTILATOR(S) (UPBLAST)

A. Manufacturers:

1. Captive-Aire, Inc.
2. Greenheck Fan Corporation.
3. Acme Engineering & Manufacturing Corporation.
4. Twin City Fan & Blower.
5. Loren Cook Company.

B. Power ventilators for use for grease (kitchen) hood exhaust shall comply with UL 762.

C. Variable-Speed Make-up and Exhaust Air Systems: For these systems, the makeup air unit and the kitchen hood exhaust fan shall be provided by the same manufacturer.

D. Housing: Removable, spun-aluminum, dome top and outlet baffle to direct air upwards.

1. Provide spun-aluminum discharge baffle to direct discharge air upward, with grease collector, rain and snow drains.

E. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone welded solid to Base.

1. Hinged Sub-base: Factory installed galvanized-steel hinged arrangement permitting service and maintenance. Include restraints to hold fan above roof and to prevent fan from hitting curb, grease collector, or curb cant, when opened.
2. Provide flexible electrical cable, with slack required, inside housing to permit use of hinged subbase for inspection and cleaning

F. Fan Wheels: Aluminum hub and wheel statically and dynamically balanced with backward-inclined blades matched to inlet cone and with a non-stick or Teflon coating.

G. Belt Drives: Comply with the following:

1. Provide drives sized for a minimum of 150% of driven horsepower.
2. Provide resilient mounting to housing.

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3. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
4. Provide cast iron, adjustable pitch pulleys keyed to shaft.
5. Provide motor isolated from ducted airstream.
6. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed, self-aligning type bearings.
 - c. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
7. Fan Shaft:
 - a. Provide turned, ground, and polished steel shaft.
 - b. Key shaft to fan wheel.

H. Overload (Running) Protection:

1. Provide motor overload protection as a requirement of this section.
2. Provide motor overload protection as recommended by the manufacturer.
3. Comply with the Section 230513 "Motors for HVAC Equipment."

I. Accessories:

1. Provide disconnect switch.
2. Grease (Kitchen) Hood Fan Curb: Provide curb height necessary to terminate fan discharge a minimum of 40" above the finished roof surface.
3. Grease (Kitchen) Hood Fan: Provide cleanout port.
4. Security Bars: Comply with Division 23 Section, 233300 "Air Duct Accessories"

2.5 CEILING-MOUNTED VENTILATORS

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City Fan & Blower.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

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- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Provide accessories:
 - 1. Variable-Speed Controller: None. Provide manual damper on inlet for initial (rough) balancing.
 - 2. Filter: Washable aluminum to fit between fan and grille.
 - 3. Isolation: Rubber-in-shear vibration isolators.

2.6 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. Twin City Fan & Blower.
- B. Housing: Manufacturer's standard steel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units (where indicated in Fan Schedule): Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Electrically-Commutated Motor (where direct drive fans indicated):
 - 1. Motor enclosure: Open type.
 - 2. Motor shall be DC electronic commutation type motor (ECM).
 - 3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
 - 4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
 - 5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Belt-Driven Units (where indicated in Fan Schedule): Motor mounted on adjustable base, enclosure 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. Provide accessories:
 - 1. Variable-Speed Controller: None. Provide manual damper on inlet for initial (rough) balancing.
 - 2. Companion Flanges: For inlet and outlet duct connections.

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3. Motorized Dampers: Parallel-blade dampers mounted in duct with electric actuator; wired to close when fan stops. When fan voltage exceeds 220 V, provide 50VA minimum transformer to operate damper.

2.7 PROPELLER FANS

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City Fan & Blower.

- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

- D. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Provide accessories:

1. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
2. Wall Sleeve: Galvanized steel to match fan and accessory size.
3. Weathershield Hood: Galvanized steel to match fan and accessory size.
4. Weathershield Front Guard: Galvanized steel with expanded metal screen.
5. Variable-Speed Controller: None. Provide manual damper on inlet for initial (rough) balancing.
6. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
7. Motorized Dampers: Parallel-blade dampers mounted in duct with electric actuator; wired to close when fan stops. When fan voltage exceeds 220 V provide 50VA minimum transformer to operate damper.

2.8 CENTRIFUGAL ROOF VENTILATOR(S) (TUBE AXIAL UPBLAST, SMOKE CONTROL)

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. Twin City Fan & Blower.
3. Greenheck Fan Corporation.
4. Loren Cook Company.

- B. Listings: UL listing for "Power Ventilators for Smoke Control Systems".

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- C. Housing: Tubular heavy gauge welded steel, housing and bearing support shall be constructed of welded structural steel member to prevent vibration and rigidly support the shaft and bearings. Windbands shall be constructed of galvanized heavy gauge steel with reinforced edges.
- D. Base (Curb Cap): Heavy gauge steel, pre-punched mounting flange and integral venturi inlet.
- E. Fan Wheels: Statically and dynamically balanced steel blades continuously welded to heavy duty hubs. A standard square key or tapered bushing shall lock the propeller to the fan shaft. Hubs shall be two piece aluminum castings that securely lock the blades in place.
- F. Belt Drives: Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower and a minimum of two.
 - 2. Provide resilient mounting to housing.
 - 3. OSHA weatherhood and belt guard
 - 4. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 - 5. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 - 6. Provide motor isolated from ducted airstream.
 - 7. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 - 8. Fan Shaft:
 - a. Provide turned shaft.
 - b. Provide ground shaft.
 - c. Provide polished steel shaft.
 - d. Key shaft to fan wheel.
- G. Fan/Motor Shaft:
 - 1. Provide motor manufacturer's standard shaft.
 - 2. Key shaft to fan wheel.
- H. Motors and drives:
 - 1. Mount on vibration isolators.
 - 2. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - 3. Make readily accessible for maintenance.
- I. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
- J. Wind-band: Join to curb-cap with leak-proof continuously welded seam.

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- K. Accessories:
 - 1. Provide disconnect switch, Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.

2.9 CENTRIFUGAL ROOF VENTILATOR(S) (DOWNBLAST, SMOKE CONTROL)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
- B. Listings: UL listing for "Power Ventilators for Smoke Control Systems".
- C. Housing: Removable, spun-aluminum dome top and outlet baffle, or extruded-aluminum, rectangular top to direct discharge air downward.
- D. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.
- E. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.
- F. Belt Drives: Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower and a minimum of two.
 - 2. Provide resilient mounting to housing.
 - 3. OSHA weatherhood and belt guard
 - 4. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 - 5. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 - 6. Provide motor isolated from ducted airstream.
 - 7. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.
 - c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 - 8. Fan Shaft:
 - a. Provide turned shaft.
 - b. Provide ground shaft.
 - c. Provide polished steel shaft.
 - d. Key shaft to fan wheel.
- G. Fan/Motor Shaft:
 - 1. Provide motor manufacturer's standard shaft.
 - 2. Key shaft to fan wheel.

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- H. Motors and drives:
 - 1. Mount on vibration isolators.
 - 2. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - 3. Make readily accessible for maintenance.
- I. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
- J. Wind-band: Join to curb-cap with leak-proof continuously welded seam.
- K. Accessories:
 - 1. Provide disconnect switch, Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.

2.10 CENTRIFUGAL ROOF VENTILATOR(S) (LOUVERED SUPPLY, SMOKE CONTROL)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Twin City Fan & Blower.
 - 3. Greenheck Fan Corporation.
 - 4. Loren Cook Company.
- B. Housing: Roof mounted, filtered supply fans shall be of the belt-driven, double width/double inlet, centrifugal blower type. Hoods shall be louvered penthouses constructed of heavy gauge extruded aluminum louvers with mitered corners. Hoods shall include insulated, hinged aluminum covers and have a set of four tie down points. Base panels shall have prepunched mounting holes.
- C. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with flat blade backward-inclined blades, constructed of heavy gauge steel.
- D. Filters: Permanent washable 2 in. aluminum filters.
- E. Belt Drives: Comply with the following:
 - 1. Provide drives sized for a minimum of 150% of driven horsepower and a minimum of two.
 - 2. Provide resilient mounting to housing.
 - 3. Belt(s):
 - a. Provide grip notch belt(s).
 - b. Provide belt tensioner.
 - 4. Provide cast iron, adjustable pitch pulleys keyed to shaft.
 - 5. Provide motor isolated from ducted airstream.
 - 6. Shaft Bearings:
 - a. Provide permanently lubricated pillow block type.
 - b. Provide sealed bearings.

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- c. Provide self-aligning type.
 - d. Provide ball bearings selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed.
 - 7. Fan Shaft:
 - a. Provide turned shaft.
 - b. Provide ground shaft.
 - c. Provide polished steel shaft.
 - d. Key shaft to fan wheel.
 - F. Fan/Motor Shaft:
 - 1. Provide motor manufacturer's standard shaft.
 - 2. Key shaft to fan wheel.
 - G. Motors and drives:
 - 1. Mount on vibration isolators.
 - 2. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
 - 3. Make readily accessible for maintenance.
 - H. Overload (Running) Protection:
 - 1. Provide motor overload protection as a requirement of this section.
 - 2. Provide motor overload protection as recommended by the manufacturer
 - 3. Comply with the Section 230513 "Motors for HVAC Equipment"
 - I. Wind-band: Join to curb-cap with leak-proof continuously welded seam.
 - J. Accessories:
 - 1. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
 - 2. Provide parallel-blade dampers mounted in fan base with UL listed actuator and dampers end switches when open and closed.
 - 3. Provide disconnect switch, Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired to motor and actuator through an internal aluminum conduit.
- 2.11 MOTORS
- A. Refer to section "Common Motor Requirements for HVAC Equipment."
 - B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
 - 1. Motor Sizes: Size shall be as indicated. If not indicated, provide motor large enough to drive load and avoid operation in service factor range above 1.0.
 - 2. Controls: Provide controllers, electrical devices, and wiring to comply with requirements specified in Division 26 Sections.
 - C. Enclosure Type: Totally enclosed, fan cooled.

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2.12 FASTENERS

- A. Security: Button head 1/4" diameter by 1-1/4" long (minimum size) sheet metal screws with torx head and center reject pin.
- B. Refer to paragraph "SUBMITTALS"

2.13 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

2.14 ROOF CURB:

- A. Dishwasher and Grease Hoods: Curbs for fans serving this equipment have special dimensional requirements. Provide dimensions indicated.
- B. Minimum Height from Top of Roof Insulation for Non-Grease Fans: 12".
- C. Slope: Match structure. Top of curb shall be level and each edge shall be flush with other edges on all sides.
- D. Curb Material: Match material of power ventilator located on roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install HVAC Power Ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with security fasteners. Refer to Section "Roof Accessories" for other installation requirements for roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 0.5 inches.
- E. Install units with clearances for service and maintenance.

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F. Label units.

G. Kitchen Hood Fans:

1. Install roof-mounted exhaust fans with fan discharge a minimum of 40" above the finished roof surface. Outlet shall be not less than 10 feet horizontally from parts of the same building and adjacent buildings. Outlet shall be not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building.
2. Install sidewall exhaust fans not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building. Termination shall not be located where protected openings are required and shall not be located within 3 feet of exterior openings.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that Shipping blocking and bracing are removed.
2. Verify that unit is secure and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. For belt drive units 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 belts, adjust belt tension, and install belt guards.
5. Adjust damper linkages & operators for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control, fire, smoke, and fire/smoke dampers in connected ductwork systems are in a fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm.
9. Measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

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3.3 TESTING, ADJUSTING, BALANCING, AND LUBRICATION

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC".
- C. Replace fan and motor pulleys to achieve design airflow.
 - 1. Disable automatic temperature-control operators, energize motor and adjust fan to required rpm.
 - 2. Measure and record RPM.
 - 3. Measure and record motor voltage and amperage.
- D. Re-lubricate bearings.

END OF SECTION 233423

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SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
 - 1. Seismic Hazard Level A: Force to weight ratio = 0.48.
 - 2. Seismic Hazard Level B: Force to weight ratio = 0.30.
 - 3. Seismic Hazard Level C: Force to weight ratio = 0.15.

1.3 ABBREVIATIONS

- A. BAS Building Automation System.
- B. CFM Cubic Feet per Minute.
- C. ECM Electronically Commutated Motor.
- D. PSIG Pounds per Square Inch Gauge.
- E. PSC Permanent Split Capacitor
- F. SCR Silicon Controlled Rectifier.
- G. VA Volt Amps. (A measure of transformer power)

1.4 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

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- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Seismic restraint devices.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, bracing, and vibration isolation.
- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

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: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SERIES FAN POWERED AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Anemostat Products.
 - 2. MetalAire, Inc.
 - 3. Nailor Industries, Inc.
 - 4. Price Industries.
 - 5. Titus.
 - 6. Trane.

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- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.
- C. Casing: Single wall.
 - 1. Casing Lining: Adhesive attached, 1" thick fiberglass insulation complying with UL 181 erosion requirements, and having a maximum flame spread index of 25 and a maximum smoke developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 2. Air Inlets: Round stub connections 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 and quarter-turn latches.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Motorized Volume Damper: Galvanized steel with flow sensing element, peripheral gasket, and bearings. Operating range shall be 90 degrees.
- E. Velocity Sensors: Multipoint array with velocity sensors in inlet duct connection.
- F. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Type: ECM.
 - 2. Design: Designed for speed control. Use with a SCR or other technology for fan speed adjustment. Provide means of speed control on the terminal unit by the terminal unit manufacturer.
- G. Fan:
 - 1. Type: Forward curved centrifugal.
 - 2. Isolation: Rubber in shear.
 - 3. Speed Control: Infinitely adjustable.
- H. Filters: Where return is not ducted to unit, provide 1" thick, pleated filter, MERV 8, in filter rack at terminal unit inlet.
- I. When indicated provide an Electric-Resistance Heating Coil: Nickel-chromium 80/20 heating wire, 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.
 - 1. Control Stage(s)/Step(s): As indicated.
 - 2. Access door interlocked disconnect switch: Yes.
 - 3. High temperature limit: Downstream air temperature sensor with local connection to override discharge air temperature set point. Set point shall not exceed maximum discharge temperature set point. Discharge air temperature set point may not be used. If not used limit discharge air temperature to 180° F.

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4. Airflow switch for proof of airflow: Yes.
5. Fan interlock contacts: Yes.
6. Fuses in terminal box for overcurrent protection: Yes for coils more than 48 A.
7. Switches and relays: Yes
8. Contactor for each step of control: Yes

J. Factory mounted and wired components:

1. Electrical components and BAS unit controller mounted in control box with removable cover. Incorporate single point electrical connection to power source.
2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
3. Wiring Terminations: Fan, heat, and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
4. Disconnect Switch: Factory mounted fused.

K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit to enclose controller furnished under Section "Building Automation System".

L. Electronic Controls: Provide bidirectional damper, integral airflow measurement device, and transducer. Control devices shall be compatible with temperature controls specified in Section "Building Automation System" and shall comply with the following:

1. Install microprocessor based controller furnished under Section "Building Automation System"
2. Install damper actuator provided under this section.
3. Provide airflow transducer. Output shall be compatible with controller.

M. Control Sequence:

1. As indicated in Section "Sequences of Control."

2.2 SHUTOFF AIR TERMINAL UNITS

A. Manufacturers:

1. Anemostat Products.
2. MetalAire, Inc.
3. Nailor Industries, Inc.
4. Price Industries.
5. Titus.
6. Trane.

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- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

Casing: Single wall galvanized sheet steel.

1. Sheet Metal Thickness: Manufacturer's standard.
2. Casing Lining: Adhesive attached 1", fiberglass liner having a maximum flame spread index of 25 and a maximum smoke developed index of 50. Insulation shall comply with UL 181 erosion requirements.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment. Provide flexible connector.
4. Air Outlet: S-slip and drive connections. Provide flexible connector.
5. Access: Removable panels with airtight gaskets for access to parts requiring service, adjustment, or maintenance.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Damper Position: Normally open.

- D. When indicated, provide an Electric-Resistance Heating Coil: Nickel-chromium 80/20 heating wire, 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.

1. Control Stage(s)/Step(s): As indicated.
2. Access door interlocked disconnect switch: Yes.
3. High temperature limit: Downstream air temperature sensor with local connection to override discharge air temperature set point. Set point shall not exceed maximum discharge temperature set point. Discharge air temperature set point may not be used. If not used limit discharge air temperature to 180° F.
4. Airflow switch for proof of airflow: Yes.
5. Fan interlock contacts: Yes.
6. Fuses in terminal box for overcurrent protection: Yes for coils more than 48 A.
7. Switches and relays: Yes
8. Contactor for each step of control: Yes

- E. Factory mounted and wired components:

1. Electrical components mounted in control box with removable cover. Incorporate single point electrical connection to power source.
2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in

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control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.

3. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
 4. Disconnect Switch: Factory mounted fused.
- F. Control Sequence:
1. As indicated in Section "Sequences of Control."

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods, neoprene 1/8" thick washers and nuts.
 1. Vibration isolation washers should be used on both sides of threaded rod attachment to box to prevent vibration transmission to structure.
- B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

- A. Label each air terminal unit with tag, nominal airflow, maximum and minimum factory-set airflows, coil type if coil is included, and ARI certification seal.
- B. For hydronic coils include hose kit and control valve shrink wrapped and labeled with terminal unit tag.

PART 3 - EXECUTION

3.1 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.

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3.2 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 and for slabs equal to or more than 4" thick.
 - 4. Do not use powder actuated concrete fasteners for lightweight aggregate concretes and for slabs less than 4" 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.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to division 23 duct specification sections for metal and flexible ducts.
- C. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with tag, nominal airflow, and maximum and minimum factory set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs/labels.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

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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.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

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 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.

3.7 DEMONSTRATION

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

END OF SECTION 233600

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, mounting details, and performance data including throw, drop, static pressure drop, and noise ratings.
 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, AND REGISTERS

A. Manufacturers:

1. Anemostat.
2. Carnes.
3. Krueger.
4. MetalAire, Inc.
5. Nailor Industries.
6. Price Industries.
7. Titus.
8. Tuttle & Bailey.

B. General:

1. The basis of design for each grille register and diffuser is indicated on the drawings. The contractor shall provide equivalent products by one of the listed manufacturers.
2. Where aluminum construction is indicated blades and frames shall be extruded.
3. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.
4. Units located on walls in heavy use areas including but not limited to basketball courts, gymnasiums, and shop areas shall be heavy duty steel.
5. Finish: Powder Coated or Baked enamel, white.

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6. Finish for Exposed Ductwork: Where ductwork is exposed, diffusers, grilles and registers mounted in exposed ductwork shall be factory painted with custom color selected by Architect.
7. Finish for diffusers, grilles and registers in metal or wood ceilings, the diffusers, grilles and registers finish, and color shall match metal or wood ceiling finish with custom paint/ finish as selected by Architect.
8. Filter Grille Mounting Frame: Shall accept a 2" deep MERV 8 (30%) pleated media filter. Refer to section "Filters" for filter requirements. Provide two sets of filters for each filter grille.
9. Mounting: As Scheduled.
10. Damper Type: Adjustable opposed-blade assembly where damper is indicated on the schedule.
11. All spiral mounted exposed grilles shall match ductwork curve similar to basis of design selections or equal.

2.2 SECURITY REGISTERS AND GRILLES

A. Manufacturers:

1. A & J Manufacturing.
2. Anemostat.
3. Krueger.
4. Kees
5. MetalAire, Inc.
6. Price Industries.
7. Titus.
8. Safety Concepts; S-vent.

B. Material: Steel.

C. Finish: Baked enamel, white.

D. Maximum Security Grilles Only - Face Arrangements:

1. 3/16-inch-thick perforated faceplate with 3/16-inch diameter holes spaced 9/32 inch on center, staggered at 60 degrees.
2. Provide manual volume damper adjustable through face of grille.

E. Wall Sleeve: 3/16" steel mechanically fastened to border.

F. Damper Type: Adjustable opposed-blade assembly where indicated on schedule.

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2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Install diffusers, registers, and grilles flush with ceiling unless otherwise indicated in contract documents.
- C. 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. Install in locations indicated, as much as practical. For units installed in lay-in ceiling panels, center units in both directions in panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Linear Slot Diffuser Installation: For typical diffuser, adjust each slot diffuser so half the slots throw horizontally along the ceiling in each direction unless indicated otherwise on drawings. For linear slot diffusers above windows at building perimeter, one half of the total slots at each diffuser shall be adjusted to throw air vertically downward to wash window and the other half of the slots shall be adjusted to throw air horizontally across ceiling unless indicated otherwise.
- E. Diffusers, registers and grilles shall be supported independently of the ceiling system and shall not be supported from conduit, piping or unrelated ductwork.
- F. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

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SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

- A. Construction Filter: A filter maintained during construction to protect ductwork from construction dust, dirt, and debris. Construction filters shall be removed temporarily during balancing and permanently after the building is occupied.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated include dimensions, required operating clearances, required access clearances, and weights.
- B. Operating Characteristics: For each type of product indicated provide rated flow capacity, initial and final pressure drop at rated flow capacity.
- C. Efficiency: For each type of product indicated provide efficiency and test method.
- D. Fire Classification: For each type of product indicated provide the fire classification.
- E. Specialties and Accessories: For each type of product indicated provide furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.
- B. Replace all permanent filters with new filters of types specified.

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:

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1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

C. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

- A. Coordinate sizes and locations:
1. Within air handling units.
 2. On open return ducts during construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
1. Air Filters, and Filter-Holding Systems:
 - a. 3M.
 - b. Airguard.
 - c. American Air Filter Company, Inc. Flanders.
 - d. Camfil USA.
 - e. Columbus Industries, Inc.
 - f. Koch Filter Corp.
 2. Filter Gages:
 - a. Airguard Industries, Inc.
 - b. Dwyer Instruments Inc.

2.2 GENERAL FILTERS

- A. For return filter grilles, general filtration, and construction filters provide the following:
1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
 2. Thickness: Unless otherwise indicated thickness shall be 2".
 3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
 4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
 5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.

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6. Farr 30/30 or equal.

2.3 PRE-FILTERS

- A. Where pre-filters are indicated and for construction filters provide the following:
 1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
 2. Thickness: Unless otherwise indicated thickness shall be 4".
 3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
 4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
 5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
 6. Farr 30/30 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Position each filter with clearance for normal service and maintenance.
- B. Install filters to prevent passage of unfiltered air.
- C. Do not operate fan system until filters are in place. During construction, all ductwork must be protected from dirt and debris. Remove filters used during construction and testing. Replace all filters in units with new filters of types specified.
- D. Unit operation during construction:
 1. Install minimum MERV 8 construction filters to protect all return ductwork from dirt and debris. Supply fan shall operate at all times.
- E. Unit not operating during construction:
 1. Install plastic sheet material over all supply and return openings to protect all ductwork from dirt and debris.
 2. Fans shall be off.
- F. Construction filter installation: Adhere all edges of filter with metal foil peel-n-stick tape having an acrylic adhesive.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Check for leakage of unfiltered air while system is operating.

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- B. Air filter and installation will be considered defective if they do not pass.
- C. Prepare a report for each filter.

3.3 TESTING AND BALANCING

- A. Immediately prior to testing and balancing, install new filters of the same type that shall be permanently installed.

END OF SECTION 234100

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SECTION 237413 - PACKAGED OUTDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

- A. ABMA American Bearing Manufacturers Association. (www.abma-dc.org)
- B. ANSI American National Standards Institute. (www.ansi.org)
- C. BAS Building Automation System.
- D. CFM Cubic Feet per Minute.
- E. DDC Direct-digital controls.
- F. ECM Electrically commutated motor.
- G. FPM Feet Per Minute.
- H. HP Heat pump
- I. RTU Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central station air handling unit. This abbreviation is used regardless of whether the unit is mounted on the roof or on an equipment pad on the ground.
- J. RTU's Rooftop units. As used in this Section, this abbreviation means packaged, outdoor, central station air handling units. This abbreviation is used regardless of whether the units are mounted on the roof or on equipment pads on the ground.
- K. SS Stamped Steel
- L. VVT Variable-air volume and temperature.
- M. VUSBC Virginia Uniform Statewide Building Code
- N. W Wire
- O. WG Water Gauge

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1.3 DEFINITIONS

- A. Archival Quality: Will last a minimum of 20 years.
- B. Head end: Main temperature control computer system storing data accessible to the internet for WEB accessible systems and storing data accessible to the building system backbone for non-WEB accessible systems.
- C. HP Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations.
- D. Modulating: Able to electrically vary and stop in any position.
- E. Outdoor air: Air outside the building or taken from outdoors and not previously circulated through the building.
- F. Outdoor air measurement: Reporting of the volume of outdoor air taken into the building by RTU and reported to the building operator in CFM.
- G. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations.
- H. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- I. Record: Maintain in writing on original paper and maintain a copy in electronic format, file type Portable Document Format (*.PDF) is acceptable. Make paper copy available for inspection upon request by Owner, Owner's representative, Architect, or Architect's representative. Email electronic copy to requested email address when request is made by the Owner, Owner's representative, Architect, or Architect's representative. Document shall be "openable" by Owner and Architect's computer.
- J. Supply-Air Fan: Fan providing supply air to conditioned space.
- K. Supply air: Air entering a space from air-conditioning, heating, or ventilating equipment.
- L. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- M. Two-position: Able to electrically move and stop in only two positions. Usually open or closed.

1.4 PERFORMANCE REQUIREMENTS

- A. Support: RTU supports shall comply with required wind and seismic performance requirements, including analysis by a qualified professional engineer.

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- B. Wind-Restraint Performance shall comply with SEI/ASCE 7 for wind speed and building classification category. Provide minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- C. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. Unless otherwise indicated the term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified." The unit will not be required to operate after the event.

1.5 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: Provide manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, accessories, and mounting requirements.
- C. Exterior Color: Manufacturer's standard color shall be acceptable.
- D. Shop Drawings:
 - 1. Detail equipment assemblies, include:
 - a. Internal components
 - b. Dimensions
 - c. Weights
 - d. Loads
 - e. Supports
 - f. Required clearances.
 - 2. Provide method of field assembly.
 - 3. Indicate:
 - a. Components
 - b. Location
 - c. size of each field connection
 - 4. Provide Wiring Diagrams for:
 - a. Power
 - b. Control
 - 5. For RTU Support comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for support selection.
 - a. Calculations: Calculate requirements for selecting vibration isolation, seismic restraint where required, and for vibration isolation.

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- b. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system, curb slope, and curb dimensions.
 - c. Restraint: Detail fabrication and attachment of restraints. Indicate anchorage details, quantity, diameter, and connections.
- E. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are indicated and coordinated using input from installers:
- 1. Plan areas containing an RTU indicated at $\frac{1}{4}'' = 1' - 0''$ or greater on construction drawings.
 - 2. Areas within 20 feet of section marks indicated on M2 series drawings where such section marks penetrate an RTU.
 - 3. Structural members to which RTUs will be attached.
 - 4. Related roof openings.
 - 5. Related roof curbs, slope, dimensions and flashing.
- F. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," Provide the following:
- 1. After successful completion of testing & balancing, or commissioning provide the following:
 - a. Completed Inspection & Testing form.
 - b. Record copy of site-specific software on DVD.
 - c. Maintenance, Inspection and Testing Records including, may not be limited to, the following:
 - 1) How to test installed components.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Manufacturer's user training manuals.
 - 2. Manufacturer's required maintenance related to system warranty requirements.
 - 3. Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.
- G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

- 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
- 2. Comply with ARI 270 for testing and rating sound performance for RTUs.

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- B. System safety. Comply with one of the following:
 - 1. ASHRAE 15 for refrigeration system safety.
 - 2. ASHRAE/IESNA 90.1-2004 applicable requirements in Section 6 - "Heating, Ventilating, and Air-Conditioning."
 - 3. NFPA 90A and NFPA 90B.
 - 4. UL 1995.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to provide labor and materials to remove and replace components of RTU's that fail in materials or workmanship within the following warranty period.
 - 1. Compressors: 5 years from date of Final Acceptance.
 - 2. Gas Furnace(s): 5 years from date of Final Acceptance.
 - 3. Gas Furnace Heat Exchanger(s): 5 years from date of Final Acceptance.
 - 4. VFD: 3 years from date of Final Acceptance.
 - 5. Remainder of unit: 1 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carrier Corporation.
- B. McQuay International.
- C. YORK International Corporation.
- D. Trane

2.2 GENERAL

- A. Packaged VAV Rooftop Unit (Packaged VAV Rooftop Unit Serving Terminal Units Diagram): Provide a Packaged RTU, designed for VAV airflow, variable speed compressors, direct drive plenum supply fan(s), with gas heat exchanger (2:1 turndown), outdoor air and return air dampers, economizer, return/exhaust fan, outdoor air flow measuring station and factory installed controls as required by this specification.
- B. Packaged Gas/Electric Unit (Packaged Single Zone VAV Rooftop Unit Diagram, 5 tons and larger): Provide a packaged rooftop unit, designed for single zone variable air volume airflow,

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scroll compressor with DX cooling coil, gas heat exchanger, supply fan, outdoor air and return air dampers, hot gas reheat (dehumidification), powered exhaust fan with economizer, an outdoor air flow measuring station (where indicated on schedules or schematic diagrams) and factory installed controls as required by this specification. Include hot gas bypass on lead compressor circuit where indicated on schedules. Gas furnace to be two stage for 7-1/2 tons and larger, single stage for 5 and 6 ton units.

- C. Rooftop Unit with Energy Recovery (Rooftop Unit with Energy Recovery Diagram): Provide a packaged rooftop unit (packaged electric cool/gas heat with energy recovery), designed for single zone constant air volume airflow, variable speed or digital scroll compressors on lead circuit with DX cooling coil, gas heat exchanger, hot gas reheat, direct drive plenum supply fan, double wall casing, outdoor air and return air dampers, relief damper, pre-conditioning energy recovery (as indicated on schedule), exhaust fan, an outdoor air flow measuring station and factory installed controls as required by this specification. Gas furnace to have 4:1 turndown or greater.
- D. Packaged Gas/Electric Unit (Gas Pack "GP" units under 5 tons, "Packaged Gas/Electric Unit" diagram): Provide a packaged rooftop unit (packaged electric cool/gas heat), designed for single zone constant air volume airflow, scroll compressor with DX cooling coil, gas heat exchanger (single stage), supply fan, outdoor air and return air dampers and factory installed controls as required by this specification. Units with 300 CFM (or more) of outside air shall have a motorized outside air damper.

2.3 CASINGS

- 1. General:
 - a. Fabrication Requirements for VAV Rooftop Units and Rooftop Unit with Energy Recovery: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
 - b. Fabrication Requirements for all other units: Formed and reinforced single-wall panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
 - c. Exterior Material: Manufacturer's standard thickness galvanized steel with factory-painted finish, exterior color shall be manufacturer's standards, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - d. Interior Material for units: Galvanized steel with no finish or factory standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections.
- 2. Fan Discharge Plenum Interior Material: Galvanized steel with no finish or factory standard finish.
- 3. Insulation and Adhesive:
 - a. Comply with NFPA 90A or NFPA 90B.
 - b. Materials: ASTM C 1071, Type I.

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- c. Thickness: 2".
- d. Materials in contact with air stream shall have air-stream surface coated with an erosion- and temperature-resistant coating or they shall be faced with a plain or coated fibrous mat or fabric.
- e. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Condensate Drain Pans:

- 1. Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1-2004.
- 2. Construction: Provide foam insulation on back. Double wall, foam insulated, moisture tight drain pans are acceptable.
- 3. Drain Connection(s): Threaded nipple with pan sloped in two directions to drain.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004 and UL 181.

2.4 ECONOMIZER SECTION

- A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed blade design. Damper blades shall be as specified hereafter. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Control of the dampers shall be by factory installed actuators. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

2.5 FANS

- A. Fans except Condenser Fan(s): Refer to schedule for blade and fan configuration. Provide with permanently lubricated, motor installed on an adjustable fan base resiliently mounted in the casing. Provide aluminum wheel and steel scroll.
- B. Fan Shaft Bearings:
- 1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ANSI/ABMA 9
- Or

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2. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ANSI/ABMA 11.

C. Fan Sound-Power Levels:

1. Fans, except condenser fans, shall meet or create lower sound power levels than those indicated.
2. Fans, except condenser fans, shall comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

D. Fan Performance Rating: Except condenser fans factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

E. Condenser Fan(s): Propeller mounted on shaft of permanently lubricated motor.

F. Fan Motor(s): Refer to section "Common Motor Requirements for HVAC Equipment."

2.6 COILS

A. Indoor Air Refrigerant Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Interlaced.
3. Circuits: Minimum of one per compressor.
4. Casing: Galvanized steel.
5. Split: As indicated. If not indicated none required.

B. Outdoor Air Refrigerant Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Interlaced.
3. Circuits: Manufacturer's standard.
4. Casing: Galvanized steel.
5. Split: As indicated. If not indicated Manufacturer's standard.
6. Provide baked phenolic or cathodic epoxy coating.

C. Hot Gas Reheat Coil:

1. Aluminum fins, seamless copper tube with minimum 0.020" wall thickness, and equalizing vertical distributor.
2. Distribution: Manufacturer's standard.
3. Circuits: Manufacturer's standard.
4. Casing: Galvanized steel.
5. Split: As indicated. If not indicated Manufacturer's standard.

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2.7 COIL SECTION

- A. Fabricate coil section to allow removal and replacement of coil(s) for maintenance and to allow in-place access for service and maintenance of coil(s).
- B. Coils shall not act as a structural component of the unit.

2.8 REFRIGERANT CIRCUIT COMPONENTS

- A. Provide gauge ports with Schrader valves for measuring suction and hot gas pressure.
- B. Provide for operation of the unit for heating down to 0° F.
- C. Provide for operation of the unit for cooling down to 35° F.
- D. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- E. Refrigeration Specialties:
 - 1. Refrigerant: R-410A.
 - 2. Expansion valve with replaceable thermostatic element.
 - 3. Refrigerant filter/dryer.
 - 4. Manual-reset high-pressure safety switch.
 - 5. Automatic-reset low-pressure safety switch.
 - 6. Minimum off-time relay.
 - 7. Automatic-reset compressor motor thermal overload.
 - 8. Brass service valves and unions installed in compressor suction and discharge lines.
 - 9. Low-ambient kit high-pressure sensor.
- F. The following is required for heat pump applications:
 - 1. Four-way reversing valve with a replaceable magnetic coil
 - 2. Thermostatic expansion valve bypass check valves.
 - 3. Suction line accumulator.
- G. The following is required for applications with hot gas reheat:
 - 1. Hot-gas reheat solenoid valve with a replaceable magnetic coil.

2.9 GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
 - 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel.

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1. Fuel: As indicated.
 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
- C. Heat-Exchanger: Stainless steel for units over 5 tons, aluminized steel for units 5 tons and less.
- D. Drain Pan: Stainless steel.
- E. Venting: Gravity or power vented.
- F. Safety Controls: Manufacturer's standard in accordance with local and state code requirements.
- G. Capacity Control: As scheduled or listed previously in this specification. If not scheduled or listed previously modulating or staged control shall be provided.
1. Cycle: All heat on or off as needed
 2. Stage: Provide a minimum of 4 stages, 25%, 50%, 75%, and 100%. Maximum temperature rise at 25% shall be fifteen degrees Fahrenheit (15° F).
 3. Modulating: Heat output shall be variable down to 20% of scheduled capacity or a maximum temperature rise of fifteen degrees Fahrenheit (15° F).

2.10 AIR FILTRATION SECTION

- A. Required sections: Provide filter sections indicated. If not otherwise indicated provide MERV 8 (30% efficient) 2" thick disposable pre-filters with MERV 13 (85% efficient) 4" thick final-filters.
- B. Position: Final-filter shall be downstream of pre-filter
- C. Refer to Division 23, Section "Filters"

2.11 DAMPERS

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2% of air quantity at 2000 FPM face velocity through damper and 4" WG pressure differential.
- B. Minimum Outdoor Air Damper(s): Two position parallel or opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and intake hood. Provide method of setting minimum outdoor air.
- C. Economizer Outdoor Air Damper(s): Modulating opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and intake hood. Provide method of setting economizer maximum equal to supply air.
- D. Return Air Damper(s): Two position (modulating if mechanically interlocked with mixing damper) parallel or opposed blade galvanized steel dampers mechanically fastened to cadmium plated steel operating rod in reinforced cabinet.

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- E. Mixing Damper(s): Modulating parallel blade galvanized steel dampers mechanically fastened to cadmium plated steel operating rod in reinforced cabinet. Operating rods may be connected with a common linkage and interconnected so return and mixing dampers operate simultaneously. Dampers shall be positioned such that airflows collide to promote mixing.
- F. Relief Air Damper(s): Parallel or opposed blade galvanized steel motorized mechanically fastened to cadmium plated steel operating rods in reinforced cabinet, with bird screen and relief hood.
- G. Damper Motors:
 - 1. Fail closed.
 - a. Exceptions:
 - 1) Supply air damper shall fail open.
 - 2) Return air damper shall fail open.
 - 2. Modulating operation unless two-position is indicated.
 - 3. Adjustable minimum position.

2.12 ENERGY RECOVERY DEVICE

Rotary Wheel Heat Exchanger:

- a. The rotor shall be constructed of corrugated synthetic media providing individual flutes to channel air flow and minimize cross contamination. Rated performance shall be maintained under all differential pressure conditions. The desiccant shall be intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Media shall be non-metallic to provide corrosion resistance against attack from office, laboratory chemicals, etc. ---OR--- The rotor shall be made of aluminum coated to prohibit corrosion; etched or oxidized surfaces are not acceptable. All surfaces must be coated with a non-migrating adsorbent layer prior to being formed into the honeycomb media structure to insure that all surfaces are coated and that adequate latent capacity is provided. The desiccant must be specifically designed for the adsorption of water vapor. Verification in writing must be presented from the desiccant manufacturer confirming that the internal pore diameter distribution inherent in the desiccant being provided limits adsorption to materials not larger than the critical diameter of a water molecule (2.8 angstroms).
- b. The rotor shall provide equal sensible and latent recovery efficiencies. This must be clearly documented through a certification program conducted in accordance with ASHRAE 87-78P and ARI 1060 standards. The certification must have been conducted by a qualified independent organization. Independent wheel testing to document that the desiccant material utilized does not transfer pollutants typically encountered in the indoor air environment shall be provided from a credible test laboratory.
- c. The wheel manufacturer must have been producing the wheel product for a minimum of five years and must provide references with a successful operating history of at least four years.
- e. Ribbon-type, heat exchangers that cannot control cross contamination at all differential pressures are not acceptable.

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- f. Unless otherwise specified rotors with desiccants applied as a coating, bonded, or synthesized onto the media are not acceptable due to the potential for delamination and erosion of the desiccant material.
- h. The desiccant material shall be a molecular sieve with pore diameters ranging from 3A to 4A *or silica gel*.
- i. Wheels shall be able to withstand air stream temperatures in excess of 200°F with no deterioration of the matrix.
- j. Wheels shall be cleanable by vacuuming, blowing with compressed air (20 PSIG max.), low temperature steam, hot water, or light detergent, without degradation of latent recovery capacity.
- k. The wheel frames shall consist of evenly spaced galvanized steel spokes, aluminum outer band, and rigid center hub.
- l. The wheel construction shall allow for post fabrication wheel alignment.
- m. The wheel seals shall be neoprene non-contact bulb seals and shall be easily adjustable.
- n. Cassettes shall be fabricated of heavy-duty reinforced 16 gauge galvanized steel.
- o. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings.
- p. Drive systems shall be an AC drive motor with urethane drive belts.
- q. Heat exchangers shall be tested in accordance with ARI Standard 1060 and ASHRAE Standard 84-1991.

2.13 AIR FLOW MEASURING STATIONS

- A. Refer to Section "Building Automation System" for specific air flow measuring station requirements.
- B. Provide a 12" long plenum on the outdoor air intake, between the intake hood or louver and unit, for installation of an air flow measuring station.
 - 1. Exception: Airflow measuring station manufacturer states "in writing" that plenum is not required for specified accuracy to be achieved.
- C. Provide a 12" long plenum on the exhaust/relief air outlet, between the exhaust/relief hood or louver and unit, for installation of an air flow measuring station.
 - 1. Exception: Airflow measuring station manufacturer states "in writing" that plenum is not required for specified accuracy to be achieved.
- D. Locate air flow measuring station(s) in unit opening(s) as indicated and make connection to unit control panel.

2.14 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

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- B. Power connection shall provide uninterrupted 115V power at 22 amps, regardless of voltage supplied to unit. When power is interrupted to unit, the outlet will continue to provide power.
 - 1. Option: separate circuit to unit provided at no additional cost.

2.15 CONTROLS

A. Basic Unit Controls:

- 1. The manufacturer furnishing units and the contractor installing units under this section shall refer to, among others, Section "Building Automation System", Section "Sequences of Control", and the Seven (7) series control drawings for additional information regarding control of the equipment.
- 2. Provide control voltage transformer:
 - a. Primary Voltage: As required
 - b. Secondary Voltage: As required
 - c. Load: As required - 100 VA minimum
- 3. Unit Mounted Control Panel:
 - a. Furnish under section "Building Automation System" and install under this Section.
 - b. Interface control panel with BAS.
 - c. Provide volatile memory backup.
 - d. Provide software and firmware operational documentation including but not limited to:
 - 1) Software operating and upgrade manuals.
 - 2) Backup of Volatile Memory: On archival quality DVD or CD compliant disk, complete with data files.
 - 3) Device address list.
 - 4) Printout of software application and graphic

B. Refrigeration system control

- 1. The manufacturer furnishing equipment under this section shall provide all controls for the compressors and refrigeration system including but not limited to staging and safeties under this section.

C. Operation:

- a. Refer to section "Sequences of Operation"

2.16 ACCESSORIES

- A. Electric Gas Burner Compartment Heater: When required by unit manufacturer provide electric heater with integral thermostat to maintain minimum 50° F in gas burner compartment.

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- B. Low Ambient Operation: Provide low-ambient kit for operation down to 35° F.
- C. Guards:
 - 1. Where scheduled "SS" or if not scheduled: Provide coil guards of galvanized stamped steel, painted to match casing. Guards shall be on sides of unit. Coils shall not be clearly visible from any direction.
 - 2. Where scheduled "W": Provide coil guards of painted, galvanized-steel wire. Coils are clearly visible from nearly every direction.

2.17 ROOF CURBS

- A. Provide under this section.
- B. Height: 8" greater than the highest portion of adjacent roof insulation.
- C. Slope: Match structure. Top of curb shall be level and each edge shall be flush with other edges on all sides.
- D. Roof Deck: Remove roof deck as required for ductwork and piping installation and insulation. Where pipe chases are provided remove roof deck inside curb and inside pipe chase.
- E. Wood Blocking and Shimming: Not permitted.

2.18 STAINLESS STEEL WIRE MESH:

- A. Provide with roof curb.
- B. Material: Type 316 stainless steel 0.061" (1.8mm) diameter wire with 0.94" (10.9mm) square openings.

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 RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs or grade for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

A. Grade Mounted Unit:

1. Concrete Base:

- a. Anchor grade mounted equipment to concrete base.
- b. Install RTUs on concrete base using elastomeric pads.
- c. Minimum Deflection: 1/4".

B. Roof Mounted Unit:

1. Roof Curb

- a. Coordinate roof penetrations.
- b. Coordinate flashing with roof manufacturer.
- c. Install curb on roof structure, secure with anchor bolts and make top edges of curb level and all edges flush with each other.
- d. Secure equipment to upper curb rail (level) as recommended by equipment manufacturer.
- e. Install roof deck and roof insulation inside the curb under the equipment.
- f. Install roof curb below equipment pipe chase where pipe chase is required/provided.
- g. Eliminate roof deck and insulation below pipe chase where pipe chase is required/provided.
- h. Attach stainless steel wire mesh to deck over opening in pipe chase between roof and space below.

C. Coordination: Coordinate penetrations and flashing.

3.3 FIELD QUALITY CONTROL

A. Whether or not use of equipment is otherwise permitted, startup service, tests, and inspections must be complete prior to running unit. Failure to perform startup service, tests, and inspections prior to running equipment shall grant the owner's representative authority to have the units/equipment removed from the site at the Contractor's expense. This paragraph shall not be construed to grant the Contractor permission to use the unit(s)/equipment specified in this section of the specifications.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Record results.

C. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. Leak Test: After installation, fill water and steam coils completely with water. Connect gauge and fill valve. Pressurize to 150 PSIG with air. Visually check for water leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.

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3. Charge refrigerant coils with refrigerant and connect gauges. Use light that will show refrigerant leak and visually check for leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
 4. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Replace or repair faulty equipment.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. RTU's or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Verify that unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete.
 2. Verify that proper thermal overload protection is installed in motors, controllers, and switches.
 3. Disconnect fan drive system. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operation. Reconnect fan drive system, align and adjust belts to proper tension.
 4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 5. Verify that dampers fully open and close.
 6. Inspect dampers for proper stroke.
 7. Inspect damper blades and seals for visible defects.
 8. Inspect coil fins. Comb damaged coil fins for parallel orientation.
 9. Verify that proper thermal overload protection is installed for electric coils.
 10. Install new filters.
 11. If not direct drive place new belts on coat hook attached with 1/4" long stainless steel sheet metal screws inside unit adjacent to existing belts where no damage will occur. Including but not limited to fans, energy recovery wheels, and enthalpy wheels.
 12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
 13. Verify that smoke dampers in connected duct system fully close when unit is deactivated.
 14. Inspect for visible damage to unit casing.
 15. If included in unit inspect furnace combustion chamber for visible damage.
 16. Inspect coils, and fans for visible damage.
 17. Inspect internal casing for visible damage.
 18. Verify that labels are clearly visible.
 19. Verify that clearances have been provided for servicing.
 20. Verify that controls are connected and operable.
 21. Clean condenser coil and inspect for construction debris.

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22. If included in unit, clean furnace flue and inspect for construction debris.
23. If furnace is included in unit purge and connect gas line.
24. Remove packing from vibration isolators.
25. Inspect fan wheel for operation without vibration and binding.
26. Start unit according to manufacturer's written instructions.
 - a. Start cooling system.
 - b. Do not operate below recommended ambient temperature.
 - c. Complete startup sheets and attach 1 paper, and one "universally readable" electronic copy on USB flash drive, with startup report. Maintain a copy in electronic format, file type Portable Document Format (*.TXT, *.DOC, *.RTF, & *.PDF) file formats are acceptable. The file format must be one of those listed or the Owner and Architect must own a computer and software capable of reading the electronic file.
27. Inspect and record performance of interlocks and protective devices.
28. Verify sequence of operation.
29. Operate unit for an initial period as recommended or required by manufacturer.
30. For unit(s)/Equipment equipped with a furnace perform the following operations for minimum and maximum firing. Adjust burner for peak efficiency within operating range.
 - a. Measure and record manifold gas pressure.
 - b. Confirm proper operation of power vents.
 - c. Measure and record combustion air temperature at inlet to combustion chamber.
 - d. Measure and record flue gas temperature at furnace discharge.
 - e. Perform flue gas analysis. Measure and record flue gas carbon dioxide and oxygen concentration.
 - f. Measure and record return air temperature and volume, and supply air temperature and volume when burner is at maximum firing rate. Calculate and record heat input from the burner to the supply air.
31. Calibrate sensors including thermostats.
32. Adjust and inspect high-temperature limits.
33. With unit operating start cooling system, measure, and record the following when the ambient temperature is a minimum of 85° F:
 - a. Coil leaving air, dry and wet bulb temperatures.
 - b. Coil entering air, dry and wet bulb temperatures.
 - c. Return air, dry and wet bulb temperatures.
 - d. Outdoor air, dry and wet bulb temperatures.
 - e. Outdoor air (condenser) coil, discharge air, dry bulb temperature.
34. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply air volume.
 - b. Return air volume.
 - c. Relief/exhaust air volume.
 - d. Record relief/exhaust airflow station reading in CFM from BAS head end.
 - e. Outdoor air intake volume.
 - f. Record outdoor air intake airflow station reading in CFM from BAS head end.
35. Simulate maximum cooling demand by utilizing 100% outdoor air and lowering discharge air temperature. Record the discharge air temperature and outdoor air volume used for the simulation. During simulation operation inspect, measure, and record the following:
 - a. Compressor refrigerant suction and hot gas pressures.

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- b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

3.5 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: Within 12 months of the date of Final Acceptance, provide up to two (2) on site visits, during normal or other than normal occupancy hours as requested by owner, to assist in adjusting system.
- B. After completing testing, adjusting, and balancing clean RTU's internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, filters.

3.6 DEMONSTRATION

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

END OF SECTION 237413

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SECTION 237433 – DIRECT-FIRED MAKEUP AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This Section includes direct-fired, heating-only rooftop makeup air units.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hangers and Supports" for methods and equipment to support units.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories.
 - 1. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection.
- B. Startup service reports.
- C. Operation and Maintenance Data: For rooftop replacement-air units to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

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1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components listed below that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set for each belt-driven fan.
 - 2. Filters: One set for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Captive-Aire Systems, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Engineered Air.
 - 4. Applied Air.

2.2 PACKAGED UNITS

- A. Factory-assembled, pre-wired, self-contained unit consisting of casing, supply fan, controls, filters, and gas burner with profile plate. Units include common curbs to accommodate kitchen hood exhaust fan, on common curb.
- B. Makeup air unit shall be designed for use in variable-air volume (VAV) applications using inverter-duty supply fan motor controlled by kitchen hood control system. Coordinate with requirements in Section 114000. Kitchen hood system will include VFDs for exhaust and supply fans. Control of makeup air supply fan shall be by the kitchen hood manufacturer. The same manufacturer shall provide the makeup air unit and the associated kitchen hood exhaust fan.
- C. Provide single-point power connection to makeup air unit control panel for makeup unit and exhaust fan.

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2.3 CABINET

- A. Construction: Double wall.
- B. Exterior Casing: Galvanized steel with baked-enamel paint finish and with lifting lugs and knockouts for electrical and piping connections.
- C. Service Doors: Hinged access doors with neoprene gaskets.
- D. Internal Insulation: Fibrous-glass duct lining complying with ASTM C 1071, Type II.
 - 1. Thickness: 1 inch.
 - 2. Insulation Adhesive: Comply with ASTM C 916, Type I.
 - 3. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.
- E. Weather hood with bird screen.

2.4 ROOF CURB

- A. Full-perimeter curb of galvanized sheet metal, minimum 12 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing. Provide combination curb (Greenheck Arrangement DBC) for mounting grease hood exhaust fan on same curb as makeup air unit. Provide combination curb extension for associated exhaust fan.

2.5 SUPPLY AIR FAN

- A. Fan: Forward-curved centrifugal; statically and dynamically balanced, galvanized steel, mounted on solid-steel shaft with self-aligning, permanently lubricated ball bearings.
- B. Motor: Open drip-proof, single-speed motor.
- C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.4 service factor.

2.6 DIRECT-FIRED GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with NFPA 54, "National Fuel Gas Code"; ANSI Z83.4, "Non-Recirculating Direct Gas-Fired Industrial Air Heaters"; and ANSI Z83.18, "Direct Gas-Fired Industrial Air Heaters," for direct-fired gas furnace.
- B. Burners: Capable of modulating turndown ratio of 25:1, including electric-modulating main gas valve, motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve.
 - 1. Fuel: Natural gas.
- C. Safety Controls:

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1. Gas manifold safety switches and controls shall comply with ANSI standards.
2. Pilot: Intermittent spark igniter.
3. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
4. External gas-pressure regulator shall regulate pressure to not more than 0.5 psig.
5. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing pilot and requires airflow to be maintained within minimum and maximum pressure settings across burner.
6. Manual-Reset, High-Limit Switch: Stops burner and closes main gas valve if high-limit temperature is exceeded.
7. Gas Train: Redundant, main gas valves, electric pilot valve, main and pilot gas-pressure regulators, main and pilot manual shutoff valves, main and pilot pressure taps, and high-low gas-pressure switches.

2.7 OUTDOOR-AIR INTAKE AND DAMPERS

- A. Dampers: Leakage rate, according to AMCA 500, shall not exceed 2 percent of air quantity at face velocity of 2000 fpm through damper and pressure differential of 4-inch wg.
- B. Damper Operators: Electric.
- C. Mixing Boxes: Parallel-blade, galvanized-steel dampers mechanically fastened to steel operating rod inside cabinet. Connect operating rods with common interconnecting linkages so dampers operate simultaneously.
- D. Outdoor-Air Intake Hoods: Galvanized steel, with bird screen complying with ASHRAE 62.1-2007 and finish to match cabinet.

2.8 FILTERS

- A. Comply with NFPA 90A.
- B. Cleanable Filters: two-inch-thick, cleanable metal mesh.

2.9 CONTROLS

- A. Factory-wire connection for controls' power supply and field-wire unit to remote control panel.
- B. Makeup air unit shall include controls for unit operation. Supply fan will be variable speed with VFD and control by Section 114000. All other unit operations and safeties shall be provided by makeup air unit controls.
- C. Control center shall include integral door-interlocking disconnect and common switch for energizing supply fan and exhaust fan.
- D. Remote control panel shall have the following features:
 1. On-off-auto switch.

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2. Supply-fan indicating light.
 3. Exhaust-fan indicating light.
 4. Pilot-operation indicating light.
 5. Safety-lockout indicating light.
- E. Interlocks: Start unit when associated exhaust fan is started. Operate burner when flow switch located in exhaust duct proves airflow.
- F. Inlet Air Sensor – Provide on/off type duct stat to automatically de-energize gas system and interrupt gas flow to burner when the inlet air temperature is above the desired setting.
- G. Fan Discharge Thermostat: Controls modulating gas valve to maintain supply-air temperature.
1. Remote Discharge Thermostat: Adjustment within 20 feet of unit.

2.10 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- B. Examine roof curbs and equipment supports for suitable conditions where rooftop replacement-air units will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof curb on roof structure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure rooftop replacement-air units on curbs and coordinate roof penetrations and flashing with roof construction.
- B. Install wall- and duct-mounting sensors, thermostats, and humidistats furnished by manufacturers for field installation. Install control wiring and make final connections to control devices and unit control panel.

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3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Burner Connections: Comply with requirements in Division 23 Section "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to makeup air units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for visible damage to furnace combustion chamber.
 - 2. Verify that clearances have been provided for servicing.
 - 3. Verify that controls are connected and operable.
 - 4. Verify that filters are installed.
 - 5. Clean furnace flue and inspect for construction debris.
 - 6. Inspect operation of power vents.
 - 7. Purge gas line.
 - 8. Verify bearing lubrication.
 - 9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 10. Adjust fan belts to proper alignment and tension.
 - 11. Start unit.
 - 12. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

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13. Adjust and inspect high-temperature limits.
 14. Verify operational sequence of controls.
 15. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 16. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.
- C. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
- D. Remove and replace components that do not pass tests and inspections and retest as specified above.
- E. Prepare written report of the results of startup services.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop replacement-air units. Refer to Division 01 Section "Closeout Procedures." Video record demonstration session and provide to Owner.

END OF SECTION 237433

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SECTION 238123 – COMPUTER ROOM AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and the general provisions of the Contract Documents apply to this Section.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013.

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1.4 COORDINATION

- A. Coordinate layout and installation of computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: One set(s) for each belt-driven fan.
 - 2. Filters: One set(s) of filters for each unit.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Compu-Aire, Inc.
 - 2. Data Aire Inc.
 - 3. Koldwave, Inc.; a Mestek company.
 - 4. Liebert Corporation (Vertiv).
- B. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls.

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- C. Cabinet and Chassis: Constructed of heavy gauge galvanized steel with baked-enamel finish and shall be serviceable from only one side. Internal cabinet shall be insulated with 1/2-inch-thick duct liner that meets ASHRAE Standard 62.1 requirements for mold growth and has been tested per UL 181 standards.
- D. Air Distribution: The fan shall be a belt drive, centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.
- E. Microprocessor Control: The control system shall be microprocessor-based, factory-wired into the system cabinet and tested prior to shipment. The unit-mounted control enclosure shall include a 2-line by 16-character liquid crystal display (LCD) providing continuous display of operating status and alarm condition which is wired into the control board using 4-conductor field-supplied wire. A 7-key membrane keypad for set point/program control and unit On/Off shall be located below the display. The control shall be capable of displaying values in °F. The microprocessor shall provide three stages of cooling for direct expansion units by cycling the compressors. The microprocessor shall determine the optimal stage to run based on historical run data. Temperature and humidity sensors shall be located on unit.
 - 1. Monitoring: The LCD shall provide an On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity indication.
 - a. Control Set points:
 - 1) Temperature Set point: 65-85°F
 - 2) Temperature Sensitivity: 1-9.9°F
 - 3) Humidity Set point: 20-80% RH
 - 4) Humidity Sensitivity: 1-30% RH
 - b. Unit Controls:
 - 1) Compressor Short-Cycle Control: The control system shall prevent compressor short cycling by a three minute timer from compressor stop to the next start.
 - 2) Common Alarm and Remote On/Off: A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.
 - 3) Setback Control: The control shall be user-configurable to use a manual set point control or a programmable, time-based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.
 - 4) Temperature Calibration: The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.
 - 5) System Auto Restart: For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-

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second increments) time delay. Programming shall be possible at the unit-mounted controller.

c. Alarms:

- 1) Unit Alarm: The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:
 - a) High/Low temperature
 - b) High/Low Humidity
 - c) High water alarm – lockout unit operation
 - d) High head pressure
 - e) Power loss
 - f) Compressor short cycle
 - g) Humidifier alarm
- 2) Alarm controls: Each alarm shall be individually enabled or disabled (except for high head pressure and high water in condensate pan) and can be programmed for a time delay of 0-255 seconds of continuous alarm condition to be recognized as an alarm. Each alarm can also be enabled or disabled to activate the common alarm (except high head pressure and high water in condensate pan).
- 3) Audible Alarm: The audible alarm shall annunciate at the LCD.
- 4) Common Alarm: A programmable alarm shall be provided to interface user selected alarms with the BAS.

- F. Evaporator Coil: The evaporator section shall include evaporator coil, thermostatic expansion valve and filter driers. The evaporator coil shall have two circuits constructed of copper tubes and aluminum fins. Externally equalized thermostatic expansion valves shall control refrigerant flow. The evaporator unit shall be factory-charged with R-407C refrigerant and sealed. The coil shall be provided with a condensate drain pan, with an internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shut down the evaporator upon high water condition.
- G. Outdoor Air-Cooled Propeller Fan Condensing Unit: The condenser coil shall be constructed of copper tubes and aluminum fins with a direct-drive propeller-type fan, and shall include multiple compressors, high-pressure switches, refrigerant receivers, head pressure control valves and liquid line solenoid valves. All components shall be factory-assembled, charged with R-407C refrigerant and sealed. No internal piping, brazing, dehydration or charging shall be required. Condensing unit shall be designed for 95°F ambient and be capable of operation to -30°F. Hot gas bypass shall be provided for each circuit to reduce compressor cycling and optimize performance under low load conditions.
- H. Humidifier: The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1" air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill stem fault and end of cylinder life conditions.

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- I. Electric Reheat: The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include an agency-approved safety switch to protect the system from overheating and shall be controlled in stages.
- J. Disconnect Switch: The non-automatic, non-locking, molded case circuit interrupter shall be factory mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the unit front and mounted on the evaporator unit.
- K. Accessories:
 - 1. Remote Sensors: Provide remote temperature and humidity sensors. Sensors shall be connected by a shielded cable.
 - 2. Air Filter Box: Evaporator section shall include an air filter box for deep pleated type, MERV 8 rated filters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.
- B. Install ground mounted condensing units on equipment pad and per 230548, section 3.7 for Condensing Units.
- C. Install floor mounted indoor units per Indoor Air Handling Units per 230548, section 3.7.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

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- D. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Provide shutoff valves and piping.

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. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 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.
- C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123

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SECTION 238124 – DUCTLESS MINI-SPLIT AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ductless mini-split air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Evaporator fan units are designed for ceiling or wall mounting. The compressor-condenser unit shall be remote and located on the roof where indicated on the Drawings.

1.3 DEFINITIONS

- A. Evaporator-Fan Unit: The part of the ductless mini-split air-conditioning unit that contains a coil for cooling and a fan to circulate air to conditioned space.
- B. Compressor-Condenser Unit: The part of the ductless mini-split air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For ductless mini-split air-conditioning units to include in maintenance manuals specified in Division 1.
- D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of ductless mini-split units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered.

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- B. Units shall be tested by a Nationally Recognized Testing Laboratory and shall bear the ETL label.
- C. All wiring shall be in accordance with the governing version of the National Electrical Code.
- D. Units shall be rated in accordance with ARI Standard 210 and bear the ARI Certification label.
- E. Units shall be precharged with refrigerant for 70 feet of refrigerant tubing.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007.

1.6 COORDINATION

- A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Sheet Metal, Flashings and Roofing Accessories."

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: One year from date of Final Acceptance. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. Warranty does not include labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Liebert Corporation
 - 2. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 3. Sanyo HVAC.
 - 4. LG
 - 5. Daikin Mcquay.

2.2 WALL-MOUNTED, EVAPORATOR-FAN COMPONENTS

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- A. The evaporator section shall be designed to be wall-mounted by means of a factory supplied mounting plate. Air distribution shall be integral to the wall-mounted unit.
- B. Cabinet and Chassis: Cabinet shall be high strength molded plastic with front panel access for the filter. Cabinet color shall be white. Include drain pan with drain connection. Indoor unit shall be factory assembled, wired and tested. Contained within unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wall mounted controller shall have a self-diagnostic function, three minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant piping shall be purged with dry nitrogen before shipment from the factory.
- C. Refrigerant Coil: Evaporator coil shall be nonferrous construction with pre-coated aluminum fins on copper tubing. All tube joints shall be brazed with silver alloy. Coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.
- D. Fan and Motor: Evaporator fan shall be double inlet, forward curved, direct drive fan with a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have two speeds: low and high.
- E. Vane: Unit shall include a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower noise levels and shall close when unit stops.
- F. Filters: Return air shall be filtered with a removable and washable filter.
- G. FOUR-WAY CEILING-RECESSED CASSETTE WITH GRILLE
 - 1. General
 - a. Unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
 - 2. Unit Cabinet:
 - a. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
 - b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 - c. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
 - 3. Fan:
 - a. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
 - b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

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- c. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
 - d. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
 - e. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.
4. Filter:
- a. Return air shall be filtered by means of a long-life washable filter.
5. Coil:
- a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - b. The tubing shall have inner grooves for high efficiency heat exchange.
 - c. All tube joints shall be brazed with phos-copper or silver alloy.
 - d. The coils shall be pressure tested at the factory.
 - e. A condensate pan and drain shall be provided under the coil.
 - f. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
 - g. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.
6. Controls:
- a. This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.
 - b. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
 - c. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
 - d. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
 - e. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. General: Outdoor unit shall be the same capacity as the indoor unit and include a control board that interfaces with the indoor unit to perform all necessary operation functions. Outdoor unit shall be capable of operating at 0°F ambient temperature without additional low ambient controls. Outdoor unit shall be able to operate with a maximum height difference of 100 feet from indoor unit to outdoor unit and a maximum refrigerant tubing length of 165 feet between the indoor and outdoor unit without the need for line size changes, traps, or additional oil
- B. Casing: Casing shall be galvanized steel plate coated with an electrostatically applied thermally fused acrylic or polyester powder coating. The fan grille shall be ABS plastic.
- C. Compressor: The compressor shall be a DC rotary compressor with variable compressor speed inverter technology. The compressor shall be driven by inverter circuitry to control compressor

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speed. Compressor speed shall be varied to match space load. Outdoor unit shall include an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

- D. Refrigerant Coil: Condenser coil shall be copper tubing with aluminum fins. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be controlled by a microprocessor-controlled step motor.
- E. Fan: The fan motor bearings shall be permanently lubricated. The fan shall have horizontal discharge airflow. The fan shall be mounted in front of the coil. The fan shall include a raised guard to prevent contact with moving parts.

2.4 ACCESSORIES

1. Control: The control system shall be microprocessor-based and include one microprocessor on the outdoor unit and one on the indoor unit. Wall-mounted controller shall have a liquid crystal display indicating operating status and alarm condition and shall include a temperature sensor. A membrane keypad shall be included for program control and set point adjustment.
 2. The controller shall consist of On/Off button, increase/decrease set temperature buttons, a cool/dry/fan mode selector, timer menu button, timer on/off button, set time buttons, fan speed selector, vane position selector, a ventilation button, a test run button, and a check mode button.
 3. The controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub-cooling and discharge super heat.
 4. Normal operation of the controller shall provide individual system control in which one controller and one indoor unit are installed in the same room.
 5. The control voltage from the controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.
 6. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.
- B. Refrigerant Line Sets: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends. Pre-charge line sets in proper lengths for application. Final length shall be field verified. Refer to section "Refrigerant Piping" for additional requirements.
 - C. Factory-installed and -wired disconnect to be provided under this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

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- A. Install units level and plumb, firmly anchored, in accordance with the manufacturer's written recommendations.
- 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 Division 7 Section "Sheet Metal, Flashings and Roofing Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install compressor-condenser components on Elastomeric pads. Refer to Division 23 Section "Vibration Control for HVAC."
- E. Connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect condensate drain piping. Unit drain shall be internally trapped.
- C. Install piping adjacent to unit to allow service and maintenance.
- D. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.
- E. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

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- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 COMMISSIONING

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that units are installed and connected according to the Contract Documents.
- C. Lubricate bearings, adjust belt tension, and change filters.
- D. Perform startup checks according to manufacturer's written instructions and do the following:
 - 1. Fill out manufacturer's checklists.
 - 2. Check for unobstructed airflow over coils.
 - 3. Check operation of condenser capacity-control device.
 - 4. Verify that vibration isolation devices and flexible connectors dampen vibration transmission to structure.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 238124

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SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Propeller unit heaters with heating coils.
 - 2. Wall heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
- C. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- D. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

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- C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtherm; a Mestek Company.
 2. Carrier Corp.
 3. Daikin Applied (McQuay International)
 4. Dunham-Bush, Inc.
 5. Engineered Air.
 6. International Environmental Corp.
 7. Ruffneck Heaters, Starozik Industries Ltd.
 8. Trane.
 9. USA Coil & Air Inc.
- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Cabinet: Removable panels for maintenance access to controls.
- E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- G. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- H. Electric-Resistance Heating Coil (for electric unit heaters): Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
- I. Gas heating exchanger (for gas unit heaters): Aluminized or stainless steel heat exchanger and burners. Direct spark ignition, electronic modulating control with BAS temperature sensor input, pressure regulator.
- J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

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K. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Type: Permanently lubricated, multispeed.

L. Control Devices:

1. Unit-mounted, fan-speed switch.
2. Unit-mounted thermostat.

2.2 WALL HEATERS

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

1. Berko; Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Indeeco.
4. Markel Products; a division of TPI Corporation.
5. Marley Electric Heating; a division of Marley Engineered Products.
6. QMark Electric Heating; a division of Marley Engineered Products.
7. Trane.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

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- G. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for 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 propeller unit heaters level and plumb.
- B. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

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3.5 ADJUSTING

- A. Adjust initial temperature set points.

END OF SECTION 238239

SECTION 250800 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 220800 – Commissioning of Plumbing Systems
- D. Section 230800 – Commissioning of Mechanical Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. The purpose of this section is to specify commissioning responsibilities directly related to the Division 25 contractors and vendors. All contractors responsible for Division 25 installation or other activities shall have commissioning responsibilities described herein. Additionally, Controls Contractors responsible for controls installations under Divisions 21, 22, 23, 26, 27 and 28 shall also be responsible for the Controls Commissioning Requirements herein.
- B. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Controls Contractors alone.
- C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Controls Systems, which are a part of this project.
- D. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.

- E. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The controls trades represented on the Commissioning Team shall include but not be limited to; controls raceways, plumbing controls, HVAC controls, electrical controls, fuel system controls, lighting controls, controls integration, etc. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.
- F. Controls Contractor(s) are responsible for controls system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 23 specification sections. Controls Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- G. Sections 019113 - Commissioning General Requirements and 250800 – Commissioning of Controls Systems DO NOT relieve the Controls Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 250800 – Commissioning of Controls Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

1.3 DEFINITIONS

- A. Controls Contractor(s): The term Controls Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 25 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing systems integration verification.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

1.4 ROLES AND RESPONSIBILITIES

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vender or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and project drawings.
- B. Every Controls Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 25 Contractors are responsible for the requirements defined in specification 019113 section 1.4 subsections for their particular role:
- D. Controls Contractor(s)
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Equipment Manufacturer(s)
1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution

5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

F. Third Party Testing Agencies

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

1.5 SYSTEMS INCLUDED IN COMMISSIONING

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Systems included within the Commissioning Scope.

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
 1. Quality Control Plans and Tests
 2. Electrical Energization

3. Equipment and Systems Start-Up
4. Pre-Functional Checklist Completion
5. Third Party Testing
6. Pre-Verification Testing
7. Functional Performance Testing
8. Training and Orientation
9. Close-Out Document Review (O&M's, As-Builts, Warranties)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Work products to be provided by the Controls Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Controls Contractors, Manufacturers and Third Party Test Agencies Include:
 1. 2.1 - Project Schedule
 2. 2.2 - Submittals
 3. 2.3 - Quality Control Plan
 4. 2.4 - Quality Control Reports
 5. 2.5 - Pre-Functional Checklists
 6. 2.7 - Systems and Equipment Start-Up Plan
 7. 2.9 - Systems and Equipment Start-Up Reports
 8. 2.10 - Pre-Verification Tests
 9. 2.11 - Functional Performance Tests
 10. 2.12 - Systems and Equipment Training Plan
 11. 2.13 - Test and Proprietary Equipment
- B. Work products under the Construction Manger/General Contractor purview are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure products are up to date and accurate.

- C. Work products under the Contractors purview outside of Division 25 are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 25 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 25 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

PART 3 - EXECUTION

3.1 GENERAL

- A. Execution of Commissioning Activities to be performed by the Controls Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Controls Contractors, Manufacturers and Third Party Test Agencies Include:
1. 3.1 – Commissioning Plan and Kick-Off Meeting
 2. 3.2 – Construction Observations
 3. 3.5 – Systems and Equipment Start-Up
 4. 3.6 – Temporary Utilization
 5. 3.7 – Quality Control and Start-Up Reporting
 6. 3.8 – Pre-Functional Checklists
 - a. Controls PFC's are primarily the responsibility of the Controls Contractors. Other Contractors such as Electrical or Mechanical or Manufacturers may be required to complete portions of the Controls PFC's. For these items, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
 - b. Controls Contractors are responsible for portions of PFC's which are primarily the responsibility of other Contractors such as Electrical or Mechanical. For these items, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
 7. 3.9 – Pre-Verification Tests
 - a. Controls PVT's are primarily the responsibility of the Controls Contractors. Other Contractors such as Electrical or Mechanical or Manufacturers may be required to participate in portions of the Controls PVT's. For these activities, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
 - b. Controls Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Electrical or Mechanical. For these items,

the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.

8. 3.10 – Functional Performance Tests
 - a. Controls FPT's are primarily the responsibility of the Controls Contractors. Other Contractors such as Electrical or Mechanical or Manufacturers may be required to participate in portions of the Controls FPT's. For these activities, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
 - b. Controls Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Electrical or Mechanical. For these items, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
 9. 3.11 – TAB Verification
 - a. Test, Adjustment and Balance (TAB) is generally considered a Mechanical Trade and performed under Division 23. Controls Contractors are required to work with the TAB Contractor to manipulate systems and adjust set-points to accommodate TAB readings, measurements and adjustments.
 10. 3.12 – Integrated Systems Test
 11. 3.13 – Operations and Maintenance Manuals
 12. 3.14 – Systems and Equipment Training
 13. 3.15 – Exclusions
 14. 3.16 – Prerequisites to Substantial Completion
- B. Execution of Commissioning Activities under the Construction Manager/General Contractor purview are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure activities are executed without any impedance or interference by Division 25 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 25 are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 25 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 25 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

3.2 SCHEDULE

- A. The Controls Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Controls Systems such that all deficiencies are resolved prior to Final Acceptance.

3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES

- A. The Controls Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 25. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Controls Contractor(s). Controls Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Controls Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.4 DEFICIENCIES AND FAILURES

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.

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- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. This is referred to below as the Percent Failure Time. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. The percent of the failure time out of the total test time is calculated as follows:
1. Total Time = The total time the team is present to witness the entire test activity (including down time.)
 2. Down Time = Time spent by the Commissioning Team while waiting for reparations or waiting on any contractor to arrive or prepare their activities.
 3. Test Time = The time the test should take if execution goes correctly without delays or deficiencies.
 4. Test Time = Total Time – Down Time
 5. Percent Failure Time = Down Time / Test Time
 6. Example 1: Commissioning Team is on site for an 8 hour day but only 4 hours are effectively witnessing test activities due to a few delays: waiting for the test equipment to arrive, system adjustments are made during testing, etc. Test Time = 4. Down Time = 4. Failure Percent Time = $4 / 4 = 100\%$. Ultimately, the Commissioning Team doubled the time that should have been spent witnessing this small test. The Commissioning Agent may request reimbursement for the additional 4 hours spent on site.
 7. Example 2: Commissioning Team is on site for an 8 hour day and 7 hours and thirty five minutes are effectively witnessing test activities due to only minor system

adjustments. Test Time = 7.6. Down Time = 0.4. Failure Percent Time = $0.4 / 7.6 = 5\%$. Ultimately, the Commissioning Team spent a whole day on site which would have been needed regardless of the minor adjustments. The Commissioning Agent would not request reimbursement for the additional 25 minutes spent on site. This is considered reasonable.

- F. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- G. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- H. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

3.5 DEFICIENCY RESOLUTION

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.6 ADDITIONAL COMMISSIONING

- A. The Controls Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, additional inspections due to false PFC's, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at a rate of \$152/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager/General Contractor's Application for Payment. The Construction Manager/General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

3.7 SEASONAL COMMISSIONING

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.

- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

END OF SECTION 250800

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 SUBMITTALS

- A. Provide drawings depicting the layout of each electrical room, electrical closet, security electronics room or any other similar space in which electrical equipment will be installed using a minimum scale of 1/2"=1'-0". The drawings shall use the dimensions of the actual equipment being supplied for the project and shall include all NEC working clearances around the equipment. Drawings shall also include any the work of any other trade that will performing work in the space. Rough in may not begin until the submittal is approved by the engineer.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

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1.5 QUALITY ASSURANCE

- A. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment”.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

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2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 - 1. Fastener: Provide **torx-head** (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 - 2. Finish: Finish shall match that specified of the item anchored.
 - 3. Tools: Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1-2006. Mounting heights indicated in contract documents supersede NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

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- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

3.5 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

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END OF SECTION 260500

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. RACEWAY: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, and electrical metallic tubing.
1. Cables such as MC, AC, or Greenfield are NOT raceways.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- 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. Cerro Wire LLC.
 2. General Cable; General Cable Corporation.
 3. Southwire Company.
 4. Encore Wiring Corporation.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

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- D. Multiconductor Cable:
 - 1. Shall only be allowed where specially indicated on the drawings.
 - 2. Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M.
 - 2. Hubbell Power Systems, Inc.
 - 3. ILSCO.
 - 4. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Cooper unless Aluminum specifically indicated on the drawings
 - 1. When aluminum feeders are allowed, provide Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, conductors in raceway or Type XHHW-2, single conductors in raceway. Type SE or Type USE multiconductor cable are not allowed.
- B. Exposed Feeders: Type THHN-2-THWN-2, conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, conductors in raceway.

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- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2 conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, conductors in raceway
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, conductors in raceway, Type XHHW-2, conductors in raceway.
- H. Feeders and Branch Circuits are not permitted to be installed in Cable Tray

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- 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. Branch Circuits Concealed in Casework: MC cable may be used to feed to outlet boxes fish concealed in built-in casework. Route cable supported tight in upper inside corners of casework, not in conflict with drawers or cabinet doors.
- G. Branch Circuits Concealed Existing to Remain Drywall Partitions: MC cable may be used to feed to outlet boxes fish concealed in the drywall partition. Convert to conduit and conductor with 3' of exiting the partition.
- H. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- I. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
 - 1. Type MC Cable or FMC, with minimum #12AWG copper THHN/THWN and full size equipment grounding conductor. Maximum whip length 72".
 - 2. MC Cable and FMC shall be supported within 24" of fixture connection so that whip is not in contact with ceiling or grid. Securing to fixture support wires with batwings is acceptable but not to ceiling support wires.
 - 3. Do not connect fixture whips from fixture to fixture (daisy chain). No more than 4 whips shall be connected to any one junction box.

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- J. AC cable is not acceptable in any application.
- K. All single-phase circuits shall include a dedicated neutral (grounded) and grounding conductor, unless specifically noted otherwise.
 - 1. The intent of this is to eliminate multiwire branch circuits and allow disconnection of one circuit without requiring disconnection of other(s) as would be required to comply with NEC 210.4(B). Per NEC 310.15(B)(b) each of these neutral (grounded) conductor is not considered to be load-bearing so derating is not required.
- L. Contract drawings are based upon a maximum of 3 current-carrying conductors in a conduit. Contractor may rework indicated circuitry to install a maximum of (6) L-N circuits (120 or 277V) in a single conduit. There shall be no more than 2 each A, B, C phase conductors per homerun. Each shall have dedicated neutral (grounded) conductor.
 - 1. Do not group L-L circuits in a homerun, unless specifically indicated on the drawings.
 - 2. Where there are more than 3 current-carrying conductors in a conduit, derate conductor ampacities in accordance with NEC Table 310.15(B)(2)(a).
 - 3. When running more than 3 ungrounded conductors in a raceway, increase size of conduits beyond those indicated in contract documents, as required to not exceed NEC Chapter 9, Table 1 conduit-fill requirements. As-built drawings shall clearly indicate which circuits are grouped in homeruns.
- M. Unless otherwise indicated, minimum conductor size shall be 12 AWG.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors where permitted.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 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.

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3.6 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."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following 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 visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report 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.
- C. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning cables and retest as specified above.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

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. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Galvan Industries, Inc.; Electrical Products Division, LLC.
 4. ILSCO.
 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

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2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Grounding Electrode Conductors: For the main service and transformers within the building shall be bare stranded copper and shall be sized no smaller than that indicated on the drawings or in the NEC table 250-66.
- C. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

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- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, tele-data rooms and elsewhere as indicated.
- D. 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.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. 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.
- C. Metallic Fences:
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. When provided, 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

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point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

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- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Support Systems.

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Thomas & Betts Corporation.
 - d. Unistrut; an Atkore International company.
 2. Metallic Coatings: Hot-dip galvanized or zinc plated after fabrication. Selected for applicable load criteria.
- B. Raceway and Cable Supports: As required by NEC except in secure areas, the distance between supports shall be one half that specified by NEC. (twice as many supports as required by NEC).
- C. Conduit and Cable Support Devices: Steel hangers, two-hole straps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces shall be tamperproof include the following:
1. Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.

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- 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

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- B. 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 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.
- C. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches 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.
- C. Anchor equipment to concrete base.
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.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RGS: Rigid Galvanized Steel conduit.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.
- H. RNC: Rigid nonmetallic conduit.
- I. PVC: Schedule 40 PVC
- J. ACCESSIBLE: Conduit less than 12' above the finished floor that is capable of being exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building. Example: Conduit below 12' AFF that is above a removable ceiling tile is considered "Accessible"
- K. SECURE: Area in which inmates have supervised or non-supervised access on a routine or constant basis. Refer to Architectural drawings for the areas designated as secure. If not clearly defined, the space shall be deemed as secure.
- L. RACEWAY: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, and electrical metallic tubing.
 - 1. Cables such as MC, AC, or Greenfield are NOT raceways.

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1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allied Tube & Conduit.
 2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 3. Robroy Industries.
 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT: Steel compression type.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. 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.

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2.2 NONMETALLIC CONDUITS, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems, Inc.
 2. Electri-Flex Company.
 3. RACO; Hubbell.
 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. PVC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled NEMA 3R, Flanged-and-gasketed type, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect].

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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. MonoSystems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- 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. EGS/Appleton Electric.
 2. Erickson Electrical Equipment Company.
 3. Hoffman; a brand of Pentair Equipment Protection.
 4. Hubbell Incorporated.
 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 6. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 1. Material: Cast metal.
 2. Shape: Rectangular.
 3. Listing and Labeling: 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. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- 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 or galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Gangable boxes are not prohibited.

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2.6 FLOOR BOXES AND SERVICE FITTINGS

1. Floor boxes mounted in grade slabs shall be manufactured from cast-iron and be approved for use on grade and above grade floors.
2. Floor boxes not in grade slab shall be manufactured from stamped-steel and be approved for use on above-grade floors.
3. All floor boxes shall have four independent wiring compartments that allow capacity for up to four duplex receptacles and/or communication services. The box shall provide two 1" and two 1 1/4" conduit hubs. The box shall be fully adjustable...
4. Activation covers shall be available in flanged and flangeless versions of cast aluminum. Covers shall be available with options for tile or carpet inserts, flush covers, or furniture feed. Unless indicated otherwise, provide the following cover configurations:
 - 1) Power/Telecom Outlets: Brushed aluminum flanged with blank lid flush with floor and carpet/tile cutouts.
 - 2) Furniture Floor Feed: Brushed aluminum flanged with 1" trade size screw plug opening and one combination 1 1/4" and 2" trade size screw plug openings.
 - 3) Color and materiel shall be selected by the Architect
 - 4) The activation cover shall be listed by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors.

2.7 POKE-THRU ASSEMBLIES

1. 8" Poke-thru devices provide an interface between power, communication and audio/visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power, communication and/or A/V device outlets are required. These devices provide recessed device outlets that will not obstruct the floor area.
2. Insert: Insert body shall recess the devices a minimum of 2-3/4 inches (69mm) and have a polyester based backing enamel finished interior; ivory color. Furnish with necessary channels to provide complete separation of power and communication services. Provide compartments that allow for up to four duplex receptacles and/or communication ports
3. Body consists of an intumescent firestop material to maintain fire rating of the floor slab. Provide insert with a retaining feature to hold the poke-thru device in the floor slab without additional fasteners. Poke-thru insert shall also consist of a 3/4-inch trade size conduit stub that is connected to the insert body and a stamped steel junction box for wire splicing and connections. Stamped steel junction box shall also contain the means necessary to electrically ground the poke-thru device to the system ground
4. Activation Cover: Manufactured of die-cast aluminum alloy; finished in powder-coated color selected by the Architect. Provide with gaskets to maintain scrub water tightness. Provide cover with spring-loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

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PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground
 5. Underground Conduit: Type PVC, direct buried.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors Secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, GRC.
 2. Concealed in Ceilings and Interior Walls and Partitions: GRC.
 3. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground
 4. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Indoors Non-secure Locations: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Concealed in Masonry: GRC or PVC grouted solid after installation. Convert to metallic conduit per this specification prior to exiting the wall above ground
 5. Concealed in Poured Concrete Walls: GRC or PVC. Convert to metallic conduit per this specification prior to exiting the wall above ground
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: GRC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

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- D. Minimum Raceway Size: 3/4-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
Concealed conduit to the greatest extent possible. For all exposed and accessible conduit within the secure perimeter, provide RGS, IMC unless otherwise noted on the drawings. Refer to Architectural drawings for secure perimeter.
- F. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
 - 1. Above non-removeable or security type ceilings, junction boxes are not acceptable. Provide conduit between the fixtures.
 - 2. Within the secure perimeter, above accessible ceilings, provide Interlocked Electrical Flexible Conduit connection whips in maximum length of 4'-0". Standard FMC or MC is not acceptable in this application.
 - 3. Above accessible ceilings outside the secure perimeter provide FMC or MC connection whips in maximum length of 6'-0".
- G. AC is not acceptable in any application
- H. Do not install aluminum conduits, boxes, or fittings.
- I. Install surface raceways only where indicated on Drawings.
- J. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. All conduit shall be tight to the structure and secured with two-hole steel conduit straps. Unless indicated otherwise on the drawings, for all exposed or accessible conduit inside the secure perimeter, the distance between supports shall be one half that specified by NEC. (twice as many supports as required by NEC).
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.

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- E. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.
- J. Support conduit within 6 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs are not permitted, except as required for entry into recessed floor boxes. Conduits shall be routed below the slab within the porous fill and stub-up at the required location. Transition from PVC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above. PVC shall not be permitted exposed above the floor
- L. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- N. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

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- 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 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Special Fittings and Installations:
 - 1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints. 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.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.
- Y. 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. Retain the fire rating of any fire rated wall or assembly
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

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- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. 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.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.

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3.5 CONDUIT COLOR CODING

- A. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined below. This includes covers on boxes above lift-out and other type accessible ceilings, where identification shall also include branch circuit designation. Mark conduit a minimum of each 10'-0"
1. Blue for 120/208-volts normal circuits
 2. Black for 277/480-volts normal circuits
 3. Bright red for all conduit related to fire alarm system.
 4. Dark red (burgundy) for all conduit related to security.
 5. Green for all conduit related to NEC 701 and 702 emergency systems
 6. Orange for all conduit related NEC 700 emergency systems
 7. Brown for all conduit related to data systems.
 8. White for all conduit related to paging systems.
 9. Purple for all conduit related to TV systems or other LV systems.

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Maintain the fire rating of all fire rated walls and assemblies in which electrical raceway or boxes are installed.

END OF SECTION 260533

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.
3. Handholes and boxes.
4. Manholes.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include ductbank materials, including separators and miscellaneous components.
2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes.
4. Include warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole frame support rings.
 - e. Include grounding details.
 - f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - g. Include joint details.

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2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner no fewer than ten business days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 12 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.
- B. Install underground conduits and ductbanks per the table below. Locate a minimum of 3 feet from other utility systems (steam, chilled water, sewer, storm, etc.).
 1. Install not less than 4- #4 reinforcing bars tied to a square cage at 8' centers for conduits in ductbank under roadways.
 2. Concrete encased with a minimum envelope of 3" around each conduit *where encasement is required*.
- C. Fire pump feeders shall be, 3000 psi red concrete encased PVC-Sched 40 or GRS 36" below grade or 18" below the building slab.

2.2 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

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2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. ARNCO Corp.
 2. Electri-Flex Company.
 3. Lamson & Sessions.
 4. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512 Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- C. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- 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. Christy Concrete Products.
 2. Oldcastle Precast, Inc.
 3. Utility Concrete Products, LLC.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 2. Configuration: Units shall be designed for flush burial.
 3. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
 4. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

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2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 - 1. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
 - 2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 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. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Quazite: Hubbell Power Systems, Inc.

- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of polymer concrete , reinforced concrete, cast iron, hot-dip galvanized-steel diamond plate, or fiberglass.
 - 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. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
 - d. Quazite: Hubbell Power Systems, Inc.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features.

- C. Provide handholes when total bend of the duct exceeds 270 degrees and every 150' in overall length and as required by the service provider.

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3.2 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, 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 runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.3 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders and Branch circuits, 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways Parking lots and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.4 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, with structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, or Fiberglass enclosures with polymer concrete frame and cover, with structural load rating.
 - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Fiberglass units with polymer concrete frame and cover, with structural load rating.
 - 4. Cover design load shall not exceed the design load of the handhole or box.

3.5 EARTHWORK

- A. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- B. 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.

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- C. Cut and patch existing pavement in the path of underground ducts and utility structures

3.6 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius, both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
 - 2. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 - 3. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

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4. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. 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.
5. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
6. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
7. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
8. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
9. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
10. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
11. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

I. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than [four] [five] spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
4. Depth: Install top of ductbank at least 36 inches below finished grade unless otherwise indicated. Set elevation of bottom of ductbank below frost line.

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5. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
 6. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 8. After installing first tier of ducts, 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 inches over ducts 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.
 - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
 - b. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
 - J. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.
- 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
 - B. Unless otherwise indicated, support units on a 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.
 - C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 - D. Install handholes and boxes with bottom below frost line, below grade.
 - E. 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

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lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and other surfaces subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

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SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

[Insert Information in 2.1.A & B](#)

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. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.

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- a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic Restraint Details:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and existing equipment with new equipment in the vicinity, including other supports and seismic restraints.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

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- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: **D**
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: **D**
 - a. Component Importance Factor: 1.5.
 - b. Component Response Modification Factor: 2.5.
 - c. Component Amplification Factor: 1.0.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. 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.
- D. 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.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

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2.5 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: 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 required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for 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. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. 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.

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- E. 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.
- F. Drilled-in Anchors:
 - 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 the 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 Anchors: 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 Anchors: 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. 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.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

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3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548.16

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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. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

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- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

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2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- C. Colors for Cables Carrying Circuits at More Than 600 V:
 1. Black letters on an orange field.
 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

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- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

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2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

C. Warning Tape:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, 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.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

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1. Warning labels and signs shall include, but are not limited to, the following:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
 - c. Arc Flash Hazard Warning: Refer to Section 260574 for requirements.

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.10 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.

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4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select 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 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line 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.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

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3.2 IDENTIFICATION SCHEDULE

- A. 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 label. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Grounded (Neutral): White.
 - 5) Ground: Green.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Grounded (Neutral): Gray.
 - 5) Ground: Green.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

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- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. 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.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

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- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label with clear protective overlay. 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.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Emergency system boxes and enclosures.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.
 - j. Variable-speed controllers.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Battery-inverter units.
 - p. Power-generating units.
 - q. Monitoring and control equipment.
 - r. UPS equipment.

END OF SECTION 260553

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SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This study and its results may be performed in conjunction with those in SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY and/or SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.
 - 1. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which 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.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

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B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed and dated
 - a. Submit study report for action prior to receiving final approval of the 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 the selection of devices and associated characteristics is satisfactory.
 - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary listing the major deficiencies and recommend remedy or remediation
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 1. Protective device designations and ampere ratings.
 2. Cable size 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.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 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 the standards to 1/2-cycle symmetrical fault current.

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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: As described in "Power System Data" Article in the Evaluations.

- G. Short-Circuit Study Output:
 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 EXAMINATION

- A. Obtain all data necessary for the conduct of the study.

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1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
 2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For **relocated** equipment **and** that **which** is existing to remain, obtain required electrical distribution system data by field investigation and surveys.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field.
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 reactors, provide manufacturer and model designation, voltage rating, and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 9. Motor horsepower and NEMA MG 1 code letter designation.
 10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

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 the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. 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.

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- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
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. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Unit substation primary and secondary terminals.
 4. Low-voltage switchgear.
 5. Motor-control centers.
 6. Control panels.
 7. Standby generators and automatic transfer switches.
 8. Branch circuit panelboards.
 9. Disconnect switches.

3.3 ADJUSTING

- A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

END OF SECTION 260572

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This study and its results may be performed in conjunction with those in SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY and/or SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

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. Study results shall be used to determine coordination of series-rated devices.
 - 2. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which 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.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

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1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and equipment evaluation reports.
 - 3. 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 the 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 the selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

- A. Executive summary listing the major deficiencies and recommend remedy or remediation
- B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size 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.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study:

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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, 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.
- G. 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. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity

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is sacrificed at high fault levels. 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. 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 PROTECTIVE DEVICE 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. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. 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.
- G. 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.

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2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

- I. 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.

- J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

- K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

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. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. 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.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

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2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
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 reactors, provide manufacturer and model designation, voltage rating, and impedance.
 9. 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.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Maximum demands from service meters.
 13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 14. Motor horsepower and NEMA MG 1 code letter designation.
 15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
 16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
 17. Data sheets to supplement electrical distribution system 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.

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- 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 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. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.4 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

END OF SECTION 260573

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SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This study and its results may be performed in conjunction with those in SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY and/or SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY. Provide a clearly defined separate Executive summary for each specification section. Provide the combined study submittal labeled as "SECTION 260572"

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. All revisions required to the study upon receiving recommendations and incorporating associated plan revisions shall be included at no additional cost.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which 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.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

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- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - a. Submit study report for action prior to receiving final approval of the 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 the selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary listing the major deficiencies and recommend remedy or
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Cable size 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.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Arc-Flash Study Output:
 - 1. 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.

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- F. 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. Working distance.
 6. Incident energy.
 7. Hazard risk category.
 8. Recommendations for arc-flash energy reduction.
- G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.2 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The 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. Flash protection boundary.
 4. Hazard risk category.
 5. Incident energy.
 6. Working distance.
 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

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. Calculate maximum and minimum contributions of fault-current size.

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1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- C. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- D. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- F. 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 should not be considered beyond three to five cycles.
 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- G. Arc-flash computation shall include 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.
- H. 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 the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys.
- 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.

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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 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 per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. 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.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
 1. Motor-control center.
 2. Low-voltage switchboard
 3. Panelboards.

3.5 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 RELEASE OF ELECTRICAL EQUIPMENT

- A. The electrical equipment that is part of this study may not be released for manufacturing until this report is submitted to and approved by the Architect.

END OF SECTION 260574

SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 220800 – Commissioning of Plumbing Systems
- D. Section 230800 – Commissioning of Mechanical Systems
- E. Section 250800 – Commissioning of Integrated Automation Systems
- F. Commissioning Plan

1.2 DESCRIPTION OF WORK

- A. The purpose of this section is to specify commissioning responsibilities directly related to the Division 26 contractors and vendors. All contractors responsible for Division 26 installation or other activities shall have commissioning responsibilities described herein.
- B. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Electrical Contractors alone.
- C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Electrical Systems, which are a part of this project.
- D. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.
- E. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The electrical trades represented on the Commissioning Team shall include but not be limited to; raceway, pipe and fitting, controls, NETA test, electrical, vendors, manufacturers and thermographer. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

- F. Electrical Contractor(s) are responsible for electrical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 26 specification sections. Electrical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- G. Sections 019113 - Commissioning General Requirements and 260800 – Commissioning of Electrical Systems DO NOT relieve the Electrical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 260800 – Commissioning of Electrical Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

1.3 DEFINITIONS

- A. Electrical Contractor(s): The term Electrical Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 26 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 26 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing NETA testing or a company performing arc hazard analysis or short circuit study.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

1.4 ROLES AND RESPONSIBILITIES

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vendor or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 26 of the specifications and project drawings.

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- B. Every Electrical Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.

- C. All Division 26 Contractors are responsible for the requirements defined in specification 019113 section 1.4 subsections for their particular role:

- D. Electrical Contractor(s)
 - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
 - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
 - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
 - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
 - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

- E. Controls Contractor(s)
 - 1. Controls Contractors may be a subcontractor to the Electrical Contractor but their responsibilities are defined in specification 250800 – Commissioning of Integrated Automation Systems. Controls Contractors installing controls under Division 26 shall follow the requirements set forth in specification 250800 – Commissioning of Integrated Automation System but will apply the same requirements to the Division 26 installations for which they are responsible.

- F. NETA Test Agency
 - 1. The NETA Test Agency is a Third Party Test Agency and therefore their roles and responsibilities are defined in section H below.
 - 2. The NETA Test Agency contributes a very large part to the Commissioning Process:
 - a. NETA Test Agency is required to provide early submittals, qualifications, installation inspections, etc.
 - b. NETA Test Agency has several various report types which are all included within Quality Control requirements.

- c. Electrical Equipment Operational Testing is a NETA test requirement for any equipment or component which is specified to have NETA testing. This is accomplished by the NETA Test Agency performing a large portion of the Pre-Verification Tests and repeating these measurements as Functional Performance Tests witnessed by the Commissioning Agent. See specification 019113 section 3.10 for details regarding Functional Performance Tests.

G. Equipment Manufacturer(s)

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

H. Third Party Testing Agencies

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

1.5 SYSTEMS INCLUDED IN COMMISSIONING

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 26 Electrical Systems included within the Commissioning Scope.

1.6 COORDINATION

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
 - 1. Quality Control Plans and Tests
 - 2. Electrical Energization
 - 3. Equipment and Systems Start-Up
 - 4. Pre-Functional Checklist Completion
 - 5. Third Party Testing
 - 6. Pre-Verification Testing
 - 7. Functional Performance Testing
 - 8. Training and Orientation
 - 9. Close-Out Document Review (O&M's, As-Builts, Warranties)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Work products to be provided by the Electrical Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Electrical Contractors, Manufacturers and Third Party Test Agencies Include:
 - 1. 2.1 - Project Schedule
 - 2. 2.2 - Submittals

3. 2.3 - Quality Control Plan
 4. 2.4 - Quality Control Reports
 5. 2.5 - Pre-Functional Checklists
 6. 2.7 - Systems and Equipment Start-Up Plan
 7. 2.9 - Systems and Equipment Start-Up Reports
 8. 2.10 - Pre-Verification Tests
 9. 2.11 - Functional Performance Tests
 10. 2.12 - Systems and Equipment Training Plan
 11. 2.13 - Test and Proprietary Equipment
- B. Work products under the Construction Manager/General Contractor purview are to be coordinated with the Electrical Contractors, Manufacturers and Third Party Test Agencies to ensure products are up to date and accurate.
- C. Work products under the Contractors purview outside of Division 26 are to be coordinated with the Electrical Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 26 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 26 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

PART 3 - EXECUTION

3.1 GENERAL

- A. Execution of Commissioning Activities to be performed by the Electrical Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Electrical Contractors, Manufacturers and Third Party Test Agencies Include:
1. 3.1 – Commissioning Plan and Kick-Off Meeting
 2. 3.2 – Construction Observations
 3. 3.4 – Electrical Testing and Energization
 4. 3.5 – Systems and Equipment Start-Up
 5. 3.6 – Temporary Utilization
 6. 3.7 – Quality Control and Start-Up Reporting

7. 3.8 – Pre-Functional Checklists

- a. Electrical PFC's are primarily the responsibility of the Electrical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to complete portions of the Electrical PFC's. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.
- b. Electrical Contractors are responsible for portions of PFC's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PFC completion and accuracy.

8. 3.9 – Pre-Verification Tests

- a. Electrical PVT's are primarily the responsibility of the Electrical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Electrical PVT's. For these activities, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
- b. Electrical Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.

9. 3.10 – Functional Performance Tests

- a. Electrical PFT's are primarily the responsibility of the Electrical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Electrical FPT's. For these activities, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
- b. Electrical Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.

10. 3.12 – Integrated Systems Test

11. 3.13 – Operations and Maintenance Manuals

12. 3.14 – Systems and Equipment Training

13. 3.15 – Exclusions

14. 3.16 – Prerequisites to Substantial Completion

- B. Execution of Commissioning Activities under the Construction Manger/General Contractor purview are to be coordinated with the Electrical Contractors, Manufacturers and Third Party Test Agencies to ensure activities are executed without any impedance or interference by Division 26 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 26 are to be coordinated with the Electrical Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 26 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 26 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

3.2 SCHEDULE

- A. The Electrical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Electrical Systems such that all deficiencies are resolved prior to Final Acceptance.

3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES

- A. The Electrical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Electrical Contractor(s). Electrical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Electrical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.4 DEFICIENCIES AND FAILURES

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. This is referred to below as the Percent Failure Time. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. The percent of the failure time out of the total test time is calculated as follows:
1. Total Time = The total time the team is present to witness the entire test activity (including down time.)
 2. Down Time = Time spent by the Commissioning Team while waiting for reparations or waiting on any contractor to arrive or prepare their activities.
 3. Test Time = The time the test should take if execution goes correctly without delays or deficiencies.
 4. Test Time = Total Time – Down Time
 5. Percent Failure Time = Down Time / Test Time

6. Example 1: Commissioning Team is on site for an 8 hour day but only 4 hours are effectively witnessing test activities due to a few delays: waiting for the test equipment to arrive, system adjustments are made during testing, etc. Test Time = 4. Down Time = 4. Failure Percent Time = $4 / 4 = 100\%$. Ultimately, the Commissioning Team doubled the time that should have been spent witnessing this small test. The Commissioning Agent may request reimbursement for the additional 4 hours spent on site.
 7. Example 2: Commissioning Team is on site for an 8 hour day and 7 hours and thirty five minutes are effectively witnessing test activities due to only minor system adjustments. Test Time = 7.6. Down Time = 0.4. Failure Percent Time = $0.4 / 7.6 = 5\%$. Ultimately, the Commissioning Team spent a whole day on site which would have been needed regardless of the minor adjustments. The Commissioning Agent would not request reimbursement for the additional 25 minutes spent on site. This is considered reasonable.
- F. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- G. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- H. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

3.5 DEFICIENCY RESOLUTION

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.

- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.6 ADDITIONAL COMMISSIONING

- A. The Electrical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.
- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, additional inspections due to false PFC's, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at a rate of \$152/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager/General Contractor's Application for Payment. The Construction Manager/General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

3.7 SEASONAL COMMISSIONING

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Outdoor generators shall be tested during winter design extremes. Interior electrical equipment shall be verified during peak electrical load whether it be summer or winter. Electrical equipment will be scanned with thermal imaging with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

END OF SECTION 260800

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SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

1.4 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.5 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges, and the Contractor agrees to provide associated electrical work to make good within the specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure equipment to operate, or to operate reliably.
 - b. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period: One year from date of Final Acceptance for material and labor.
 - 3. Extended Material Warranty Period Failure Due to Transient Voltage Surges: 10 years from date of Final Acceptance.

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PART 2 - PRODUCTS

2.1 TIME SWITCHES

- 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. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. NSi Industries LLC.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, and marked for intended location and application.
 2. Contact Configuration: DPDT
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
 5. Astronomic Time: All channels.
 6. Automatic daylight savings time changeover.
 7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- 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. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries LLC.
 4. Tyco Electronics.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

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2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- 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. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
 5. Watt Stopper.
- B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
 3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.4 May be provided integral to the indoor occupancy sensors

2.5 INDOOR OCCUPANCY SENSORS

- 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. Hubbell Building Automation, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.

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6. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. When daylighting is indicated on the drawings, provide 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. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage:
 - a. Standard Height Units: In areas that have ceiling heights of 12 feet or lower, provide Watt Stopper unit DT-300 (or approved equal): Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
 - b. High Ceiling Units: In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces, provide Watt Stopper unit HB3x0 with L4 lens, or approved equal. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.

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2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- 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. Hubbell Building Automation, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lutron Electronics Co., Inc.
 4. Sensor Switch, Inc.
 5. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor:
1. Standard Range: 210-degree field of view, field adjustable from 210 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
 2. Sensing Technology: Dual technology
 3. Voltage: Dual voltage, 120 and 277 V.
 4. 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.
 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.7 LIGHTING CONTACTORS

- 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. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP.
 3. General Electric Company.
 4. Square D.
- B. Description: Electrically operated, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

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2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.8 LIGHTING GENERATOR TRANSFER DEVICE (GTR OR GTD)

- A. A device to supply power to standard fluorescent or LED egress lighting fixture from a generator source upon failure of the normal lighting circuit. The device shall be capable of bypassing the wall switch when the auxiliary generator (or central inverter) powers lighting at full intensity. The device shall consist of relay switching circuitry and shall operate at 120 or 277 VAC, 60 Hz.
- 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. Bodine.
 2. Wattstopper
- C. The device shall be listed and tested by Underwriters Laboratories in accordance with the standards set forth in UL 924, "Emergency Lighting and Power Equipment," for factory or field installation inside, on top of or remote from the fixture and shall be warranted for a full five years from date of purchase.
- D. The device may be designed to control a single fixture (3A rated) or control a 20A circuit within the space.

2.9 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- 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 written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to 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. Perform the following tests and inspections:

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1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within months from date of Final Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

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SECTION 260943 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Lighting control panels using relays for switching.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. IP: Internet protocol.
- C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- D. PC: Personal computer; sometimes plural as "PCs."

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 control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

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PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Contact closure input or a protocol signal from the security system shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays. The panel shall provide a positive indicator of relay position via contact closure input or a protocol signal to the security system.

2.2 PERFORMANCE REQUIREMENTS

- A. Interface with security system: Provide hardware to enable the security system for monitor, control, display, and record data for use in processing reports.

2.3 LIGHTING CONTROL RELAY PANELS

- 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. The basic of design product is the GE Light Sweep Control system:

1. General Electric Co.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. WattStopper.

- B. Description: Standalone lighting control panel using relays to control lighting.

- C. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

- D. Relays: Electrically operated, single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.

- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 COORDINATION

- A. Close coordination with the security contractor is required to properly interface this panel to their system. Since the security system control methodology can widely vary, a panel with flexible control options via either direct relay control or one of the many communication protocols is recommended.
- B. Prior to equipment ordering, the electrical contractor and the security contractor shall meet to determine which control mythology and interface means are required. If the security system supports a communication protocol, BACnet is the preferred transmission protocol.

3.2 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 PANEL INSTALLATION

- A. Comply with NECA 1.

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- B. Install panels and accessories according to NECA 407.
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panel cabinet plumb and rigid without distortion of box.
- E. Install filler plates in unused spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- B. Acceptance Testing Preparation: Test continuity of each circuit.
- C. Lighting control panel will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within One year from date of Final Completion.

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3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Percent Impedance for each transformer type.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include limited to the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
 2. General Electric Company.
 3. Siemens Energy & Automation, Inc.
 4. Square D; Schneider Electric. (Basis of Design)

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Aluminum or Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Indoor Transformers
1. Enclosure: Ventilated, NEMA 250, Type 2.
 - a. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Outdoor Transformers
1. Enclosure: Totally enclosed, nonventilated.
 2. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Manufacturer's standard color. Comply with NEMA 250.
- F. Taps for Transformers Smaller Than 3 kVA: None.
- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

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- I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Minimum transformer efficiencies must satisfy efficiencies promulgated within United States Code of Federal Regulations CFR Title 10 Chapter II Part 431 (Appendix A of Subpart K 2016); these efficiency levels are commonly referred to as the "DOE 2016 Efficiency.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

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3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 WARRANTY

- A. Warranty Period: Provide a warranty to repair or replace for One year from date of **Final Acceptance**.

END OF SECTION 16461

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SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Control power.
5. Accessory components and features.
6. Identification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. When a CT or metering compartment is indicated on the drawings, adhere to the requirements of the electric power utility for the project.
- C. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types for types other than NEMA 250, Type 1.
 3. Detail bus configuration, current, and voltage ratings.
 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 6. Detail utility company's metering provisions with indication of approval by utility company.
 7. Include evidence of NRTL listing for series rating of installed devices.
 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

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9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 10. Include diagram and details of proposed mimic bus.
 11. Include schematic and wiring diagrams for power, signal, and control wiring.
 12. Provide a coordination drawing of each electrical room or space contain electrical equipment using the actual dimensions of the equipment to be supplied indicating clearances and equipment dimensions.
- D. Coordination Study Report: The findings of the Section 260573 Coordination Study Report (CSR) may affect the overcurrent protective devices and fault-current withstand requirements for switchboards, panelboards, and transfer switches. Also, the preparation of the CSR is dependent on the manufacturer's data for this equipment. Therefore until Submittal final Approval is granted for the CSR, these materials shall be considered at best "Approved, pending Approval of the CSR" and not released for order.
- E. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- 1.5 PROJECT CONDITIONS
- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

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2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250-W per section) to prevent condensation.
- D. 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 Owner no fewer than ten days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.6 COORDINATION

- A. Coordinate layout and installation of switchboards 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. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fail in materials or workmanship within One year from date of Final Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include limited to the following:
 1. Square D; a brand of Schneider Electric. (Basis of Design)
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

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4. Siemens Energy & Automation, Inc.
- B. Indoor Enclosures: Steel, NEMA 250, Type 1.
- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- E. Removable, Hinged Side and Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.
- F. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- G. Pull Box on Top of Switchboard:
 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 2. Set back from front to clear circuit-breaker removal mechanism.
 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- H. Buses and Connections: Three phase, four wire unless otherwise indicated.
 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with tin-plated aluminum or copper feeder circuit-breaker line connections.
 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical or compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 3. Ground Bus: Hard-drawn copper of 98 percent conductivity, equipped with mechanical or compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical or compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- I. Service Entrance Rating: When indicated on the drawings or if used as service entrance equipment, shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

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2.2 COMPONENTS

- A. Instrument Transformers: Comply with IEEE C57.13.
 - 1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - 2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

- B. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 - 2. Switch-selectable digital display of the following:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power: Plus or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
 - i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
 - 3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

- C. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.

- D. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.

- E. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:
 - 1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
 - 2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.
 - a. Secondary windings connected through a relay or relays to control bus to effect an automatic transfer scheme.
 - 3. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.

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- F. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
 - 1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
 - 2. Conductors sized according to NFPA 70 for duty required.
- G. Provide an integral 240KA TVSS device in the switchboard connected directly to the internal buss.

2.3 SURGE PROTECTIVE DEVICES

- A. Provide all Switchboard(s) with Surge Protective Device with characteristics as specified in Section 264313 – Surge Protective Devices.
- B. Surge protective device mounting:
 - 1. Provide separated SPD enclosure of NEMA 250 type matching the enclosure of equipment being protected. The enclosure shall be suitable for the location in which it is installed, indoors or outdoors. Install the SPD unit with no more than 6'-0" conductor length to SPD disconnecting means circuit breaker, ground and neutral buss of the equipment served.
 - 2. Mounted integral with the equipment, and listed for use with the equipment provided. Provide integral disconnecting means.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. All breakers feeding panelboards on the life safety, legally required and optional standby systems shall be LSI (long time, short time and instantaneous) mission critical breakers. Upsize the breaker frame size as required.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.5 GROUND FAULT PROTECTION

- A. 480Y/277V, 4-wire, connected equipment having multiple sources shall have a modified differential ground fault system (MDGF). The manufacturer shall complete the MDGF design prior to building equipment to insure that the proper main or tie breaker (s) operate properly during the following occurrences on the main bus.
 - 1. Insure the system will trip with the occurrence of a ground fault at any location in the switchgear.
 - 2. Insure system will not trip without ground fault and with normal current flow.

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3. Insure system will not trip due to large single-phase currents.
 4. Insure system will trip with combination of normal current flow and ground fault current flowing together.
 5. Insure system will not trip with circulating currents through the neutral due to multiple grounds and sources external to the immediate low voltage power sources.
- B. The manufacturer shall be required to include additional CT's, ground fault relays, interlocks, wiring, components etc. to insure the ground fault systems operates without nuisance tripping on the main bus of the switchgear.
- C. The manufacturer shall include a wiring diagram of the MDGF system along with a test procedure using high current injection equipment.

2.6 IDENTIFICATION

- A. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.
1. Mimic-bus segments coordinated with devices in switchboard sections to which applied, to produce a concise visual presentation of principal switchboard components and connections.
 2. Show the entire single line switchboard bus work, as depicted on the factory record drawing, on an engraved laminated plastic nameplate. The nameplate shall be at least .0625 inch thick and located at eye level on the front cover of the switchboard incoming service section.
- B. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Laminated drawing (24"x30" min) attached to wall adjacent to door to electrical room. Include as-built data for low-voltage power switchboard and connections as follows:
1. Frame size of each circuit breaker.
 2. Trip rating for each circuit breaker.
 3. Conduit and wire size for each feeder.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 2-inch (50-mm) nominal thickness. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
- G. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

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- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 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 switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Switchboard will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of 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.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories;

END OF SECTION 262413

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Provide a coordination drawing of each electrical room or space contain electrical equipment using the actual dimensions of the equipment to be supplied indicating clearances and equipment dimensions.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

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- D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. 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.

- E. Coordination Study Report: The findings of the Section 260573 Coordination Study Report (CSR) may affect the overcurrent protective devices and fault-current withstand requirements for switchboards, panelboards, and transfer switches. Also, the preparation of the CSR is dependent on the manufacturer's data for this equipment. Therefore until Submittal final Approval is granted for the CSR, these materials shall be considered at best "Approved, pending Approval of the CSR" and not released for order.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- B. Comply with NFPA 70.

1.6 PROJECT 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.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.

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Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fail in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Final Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures:
1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 1.
 - b. Exterior Locations: NEMA 250, Type 3R
 - c. Kitchen and areas subject to water and corrosion: NEMA 250, Type 4X
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Finishes:
 - a. Panels and Trim: 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: Same finish as panels and trim.
 4. Directory Card: Inside panelboard door, mounted in transparent card holder, with metal frame.
- B. Incoming Mains Location: Top or bottom.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

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- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- G. All branch breakers over 60A in panelboards on the life safety, legally required and optional standby systems shall have LSI (long time, short time and instantaneous) settings. All main breakers in panelboards on the life safety, legally required and optional standby systems shall be LI mission critical breakers. Upsize the breaker frame size as required.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work limited to the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric. (Basis of design)
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include limited to the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric. (Basis of Design)
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

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- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
- 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- 3. Siemens Energy & Automation, Inc.
- 4. Square D; a brand of Schneider Electric.

- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

- 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

- C. Arc Energy Reduction. Where the highest continuous current trip setting of a circuit breaker is rated or can be adjusted to is 1200 A or higher.

- 1. Provide one of the following methods to reduce clearing time
 - a. Zone-selective interlocking
 - b. Differential relaying
 - c. Energy-reducing maintenance switching with local status indicator
 - d. Energy-reducing active arc flash mitigation system
- 2. Indicate the method of compliance in the submittals
- 3. Provide documentation how the breaker is authorized to be installed, operated, and/or inspected
- 4. Contractor shall adhere to the documentation and post the information at the location of the circuit breaker(s).

2.5 MINI UNIT SUBSTATIONS

- A. UL Listed and tested assembly consisting of

- 1. Primary and Secondary Main Circuit Breaker
 - a. Circuit breaker ratings are selected to meet National Electrical Code (NEC) requirements and to coordinate with transformer magnetizing inrush current
- 2. Sealed Step-Down Transformer
 - a. 185°C (365°F) insulation with 115°C (239°F) temperature rise

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- b. Sealed, epoxy-resin encapsulated transformer
- 3. Distribution Panelboard
 - a. Panel section has copper bus and uses standard circuit breakers. Tandem breakers are not allowed.
 - b. Feeder circuit breakers are standard plug-on type

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Each panelboard section shall not exceed 42 single poles.
- C. Panelboards 400A and less shall not exceed 20 in. (508 mm) wide by 5.75 in. (223 mm) deep

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

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- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. This includes thermo graphic survey. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a report that identifies panelboards included and that describes scanning results. Include IR color photos of each panel scanned. For panels with defects found, include "before" and "after" defect is repaired. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262550 – GENERATOR DOCKING STATIONS

PART 1 - GENERAL

1.1. 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. ETL/UL LISTED
- C. UL 50 LISTED

1.2. COORDINATION

- A. Coordinate layout and installation of Generator Docking Station, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels

1.3. GUARANTEE/WARRANTY

- A. Manufacturer Warranty shall be provided for a minimum of 1 Year,
 - 1. Extended Warranty will be supplied upon at user's request at an additional charge from Manufacturer.
- B. The equipment installed under this contract shall be left in proper working order
- C. New materials and equipment shall be guaranteed against defects in composition, design or workmanship. Guarantee certificates shall be furnished.

PART 2 - PRODUCTS

2.1. DOCKING STATION

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Basis of Design - TRYSTAR: Dual Purpose Docking Station DBDS-5
 - 2. Asco
 - 3. Eaton

2.2. GENERAL REQUIREMENTS

- A. Enclosure
 - 1. NEMA 3R Rain-Tight Aluminum Enclosure

- i. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
 - ii. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use
 - iii. Front and Side shall be accessible for maintenance
 - iv. Top, Side, and Bottom shall be accessible for permanent cabling
 2. Powder coat
 - i. Paint after fabrication shall be Hammer tone Gray
- B. Phase, Neutral, and Ground Busbar
 1. Material: Silver-plated Copper
 2. Equipment Ground Bus: bonded to box.
 3. Isolated Ground Bus: insulated from box.
 4. Ground Bus: 50% of phase size.
 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
- C. Temporary generator and Load Bank connectors shall be Camlok style mounted on gland plate.
 1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
 2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
 3. Camlok connection shall be protected against accidental contact while not in use
- D. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier
- E. Short Circuit & Withstand Rating
 1. Shall be minimum 65 KAIC unless otherwise indicated on drawings
- F. Voltage & Amperage
 1. [Insert Amperage & Voltage Requirements]
- G. Factory Installed Phase Rotation Monitor Device:
 1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed
- H. Breaker Disconnects in Permanent Line, Temporary Line, and Temporary Load Bank Positions
 1. Must be UL 489 Listed Breaker

2. Breakers shall be removable for service and maintenance
 3. Interlocked permanent line breaker and temporary line breaker
- I. Additional accessories shall be included in submittal drawing as follows:
1. SCADA Terminal Port
 2. Kirk Key Door Interlock
 3. Listed Monitoring Device
 4. Surge Protection Device
 5. Utility Light/Alarm

PART 3 - EXECUTION

3.1. EXAMINATION

- A. Examine elements and surfaces to receive Generator Docking Station for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected

3.2. INSTALLATION

- A. Surface, Flush or Base Mounted: Determined by Application
 1. Install anchor bolts to elevations required for proper attachment to Generator Docking Station.

3.3. IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- C. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4. FACTORY COMMISSIONING

- A. Upon completion of the installation, the docking station shall be commissioned by the Manufacturer's factory authorized technician.
- B. SCOPE OF WORK SHALL INCLUDE:
 1. Review and verify the installation of all components and verify the correct electrical flow as depicted on the one-line drawings.

2. (If Applicable) The Manufacturer's authorized technician will set the long time, short time, instantaneous and ground fault protection settings on the Generator Docking Station circuit breaker(s) in accordance with the engineer's specifications or as provided as part of the coordination study.
3. Factory training for on-site personnel to educate them on how to connect the GDS to a portable generator.
4. The Manufacturer's factory authorized technician shall, upon completion of the commissioning provide a written report to the electrical contractor and electrical engineer indicating the completion of the work.
5. Any issue that is found during the start-up that is determined at that time to be a warranty issue will be covered by Manufacturer. Any issues that are specific to the scope for the electrical installing contractor are the sole responsibility of the installing contractor.
6. Upon successful completion of the commissioning, provide a complimentary 12-month warranty extension, above and beyond the 12-month manufacturer warranty.

3.5. FIELD QUALITY CONTROL

- A. Third Party Tests and Inspections to include the following:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Prepare test and inspection reports, including a certified report that identifies Generator Docking Station and that describes scanning results. Include notation.

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SECTION 262713 - ELECTRICITY METERING

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 equipment for electricity metering by Owner.

1.3 DEFINITIONS

- A. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

1.7 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.

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PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- 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. E-Mon.
 2. National Meter Industries.
 3. Square D.
- B. General Requirements for Owner's Meters:
1. Comply with UL 1244.
 2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in ANSI C12.20.
 3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
 4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
 5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
 6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
 7. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
- C. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

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1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262713

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SECTION 262714 - UTILITY SERVICE ENTRANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract Documents apply to the work of this section.

1.2 SUMMARY

- A. This Section includes work required to allow Utility Company to provide power to the project, as well as provisions for Utility Company metering.
- B. The Owner will pay all charges levied by the Power Company for the underground service. The Contractor shall assist the Owner with the application for electrical service.
- C. The power company will furnish **480Y/277V**, three phase, 4-wire, 60-Hz underground service.

1.3 COORDINATION

- A. All work shall be in accordance with the Power Company standards. This shall not modify the scope of work indicated in the Contract Documents; only clarify the means and methods to be in compliance with Utility requirements. Communicate to the Architect any variance from the Contract Documents required by the Utility prior to bid.
- B. Coordinate work with the power company within 30 days of notice to proceed. Notification shall be in writing with a brief construction schedule included. Provide the name and telephone number of contact person (installation supervisor). Subsequent to notification, schedule a preconstruction meeting be held at the power company's District Office or other location and time acceptable to the power company. Representatives of the general Contractor and appropriate sub-contractors shall attend. A power company Construction Department representative will review the proposed construction schedule and discuss any construction practices and/or methods applicable to the project. No work shall commence until construction schedule and ductbank installation drawings are approved by the power company.
- C. The Contractor shall notify the power company when the site is cleared and allow at least five weeks after the site is cleared for temporary power to be brought to the site.
- D. The Contractor shall notify the power company at least seven days prior to beginning of duct bank construction.
- E. Equipment fault current ratings shown on the documents are based on preliminary information provided by the Power Company and are shown for bidding purposes only. Exact available fault current values at the service connection point will be determined by the Power Company

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after the project is awarded. Verify equipment fault current interrupting capacity requirements prior to ordering electrical distribution equipment in accordance with Section 260572 "Overcurrent Protective Device Short Circuit Study." Provide a copy of the Power Company's calculated maximum available fault current to the Architect.

F. CONTACT INFORMATION

Greg Mobley
Four county Electric Co-op
Field Engineering Staking Supervisor
Office 910-259-1855
Main 888-368-7289
Cell 910-271-4107
Fax 910-259-1817
Mobley, Greg <gregmobley@fourcty.org>

PART 2 - PRODUCTS

2.1 SPECIFICATION

- A. Products required by this Section are specified in other Sections or are furnished/specified by the Utility Company.

2.2 CONTACT INFORMATION

Jimmy Smith
jimmysmith@fourcty.org
910-259-1821
Burgaw Corporate Headquarters
1822 N.C. Highway 53 West
Burgaw, NC 28425
Phone number: (888) 368-7289 or (910) 259-2171
Fax number: (910) 259-1860

2.3 UTILITY COMPANY PROVIDED WORK AND MATERIALS

- A. Pad mounted transformer.
B. Primary conductors and terminations to the transformer.
C. Cable terminations at secondary bushings of transformer.
D. Conduit seal on the transformer end of Contractor -provided conduits to company transformer.
E. Metering circuitry from CT Cabinet to meter.

2.4 CONTRACTOR PROVIDED WORK AND MATERIALS

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- A. Excavation and backfill for primary and secondary service ductbanks.
- B. Conduit ductbank for Utility Company primary conductors to transformer.
- C. Transformer pad as directed by Utility Company.
- D. Grounding at service entrance and transformer pad.
- E. Service switchboard with Utility-Approved CT section.
- F. Ductbank from utility pad mounted transformer to service switchboard CT section, with conductors terminated in switchboard.
- G. Conduit seals in accordance with Utility Company requirements.
- H. Installation of meter base furnished by Power Company.
- I. 1-1/4" concealed empty conduit from CT section to utility meter base.

PART 3 - EXECUTION

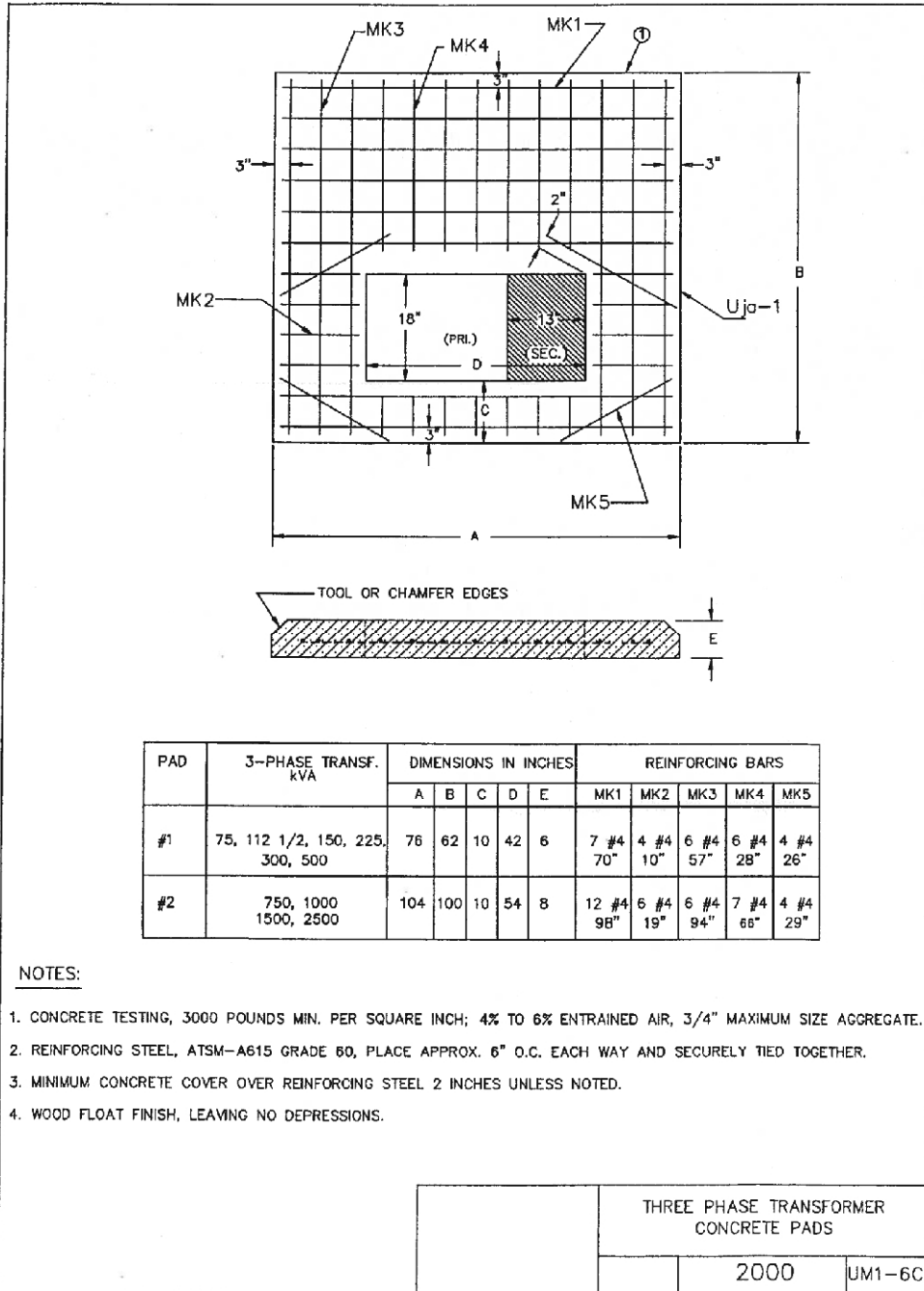
3.1 INSTALLATION

- A. Power company requires at least five weeks lead time after site is cleared to provide temporary and permanent power to the building. Coordinate construction schedules with the power company.
- B. Upon completion of duct bank installation, cap ends of conduits to prevent entry of debris. Provide 500 pound stress polyolefin pull lines in all conduits to accommodate the pulling of cables. Prior to Contractor or power company conductor installation, Contractor shall rod all conduits with a mandrel having a diameter of 1/4 inch less than the bore diameter of the conduit, and brush full length with a stiff wire brush.
- C. Furnish two (2) copies of as-built drawings showing the actual location and installation of the duct bank to the power company.
- D. Backfilling shall be compacted to achieve at least a modified Proctor 95 rating.

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PART 4 - DETAILS

4.1 Provide Pad #2 as detailed below for each service.



END OF SPECIFICATION 262714

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Communications outlets.
 - 3. Snap switches and wall-box dimmers.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 - 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. Cooper Wiring Devices, Inc.
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.3 GFCI RECEPTACLES

- A. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

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. Hubbell.
 - b. Pass & Seymour/Legrand (Pass & Seymour).

2.4 TOGGLE SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Manufacturers:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

C. Switches, 120/277 V, 20 A:

1. Description: Refer to drawings for pole configuration

D. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with lighted handle, illuminated when switch is "ON."

E. Key Switch

1. Tumbler style maximum security grade harden lock keyed per the owners requirements.
 - a. Provide a enclosed single pole or three way operator on the rear of the operator as specified o the floor plans.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

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1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , extra-duty rated, while-in-use, die-cast aluminum with lockable cover.
- C. Secure and inmate accessible locations (as defined by the architectural plans)
1. Plate-Securing Screws: Torx head, 1/4x20 center rejection pin type stainless steel screws for all device plates within the project.
 2. Material for Finished Spaces: Heavy duty, die formed, 10 gauge, cold rolled steel finished in baked white enamel with openings to suit devices. Security wall plates shall be equal to:
 - a. Fail-Safe SSB/SPC series
 - b. Hubbell SWP series
 - c. Kenall WSP/WPP series
 3. Back Plate: Heavy duty, 12 gauge steel back plates with locking wings shall be set in place during construction of masonry walls, poured in place concrete and pre-cast assemblies. Steel back plates installed in masonry construction shall be solidly grouted in place.
 4. Provide seamless wall plate covers for all devices ganged in a common box.

2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide Inmate Accessible Location plates and tamper proof receptacles in all inmate accessible and secure areas. as defined by the architectural plans.
- B. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- C. Coordination with Other Trades:
1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

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2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.

3.3 WARRANTY

- A. Warranty: Replace devices that fail in materials or workmanship within One year from date of Final Completion.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

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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 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.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

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1.4 FIELD CONDITIONS

- A. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Bussmann; a division of Cooper Industries.
 - 2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
 - 3. Littelfuse, Inc.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

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- 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. Service Entrance: Class L, time delay.
- 2. Feeders: Class RK1, time delay.
- 3. Motor Branch Circuits: Class RK5, time delay.
- 4. Large Motor Branch (601-4000 A): Class L, time delay.
- 5. Power Electronics Circuits: Class J, high speed.
- 6. Other Branch Circuits: Class RK1, time delay.
- 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

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

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 5. 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.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers 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 enclosed switches and circuit breakers.
 2. 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.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source 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 a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.7 PROJECT 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.
- B. Interruption of Existing Electric Service: If indicated on the drawings, 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 **Owner** no fewer than **seven** days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without **Owner's** written permission.
 4. Comply with NFPA 70E.

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1.8 COORDINATION

- 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.

PART 2 - PRODUCTS

- 2.1 All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

2.2 NONFUSIBLE & FUSIBLE SWITCHES

- 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. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D.

- B. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, 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. Auxiliary Contact Kit: **One** NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: When indicated on the drawings, Labeled for use as service equipment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- 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. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.

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4. Square D.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
 - C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - E. 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^2t response.
 - F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
 - G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
 - H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
 - 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.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; **integrally mounted, self-powered** type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

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2.4 MOLDED-CASE SWITCHES

- 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. Eaton Electrical Sector; Eaton Corporation.
 2. General Electric Company.
 3. Siemens Industry, Inc.
 4. Square D.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Kitchen and Wash-Down 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.

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.

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3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Install fuses in fusible devices.
- C. Comply with NECA 1.

3.3 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.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. 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. 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.
 - 4. 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.

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- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. 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.

END OF SECTION 262816

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SECTION 262913 - ENCLOSED 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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.
 - 3. Combination magnetic starter/disconnect switch.
- B. Related Section:
 - 1. Division 23 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

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- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
- E. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT 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 (minus 30 deg C) and not exceeding 113 deg F (45 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

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1.7 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Indicating Lights: Two of each type and color installed.
 - 2. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
 - 3. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.
 - 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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.
 - 5. Red pilot light.
- C. Magnetic Controllers: Full voltage, across the line, electrically held.

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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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Configuration: Nonreversing.
 3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 120V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices, remotely located pilot, indicating, and control devices.
 - a. CPT Capacity: 500 VA.
 6. Bimetallic Overload Relays (unless otherwise noted):
 - a. Inverse-time-current characteristic.
 - b. Class 10 tripping characteristic.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - d. Ambient compensated.
 7. Solid-State Overload Relay (smoke control SEF and OAF fans):
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- D. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
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:

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- a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
2. Fusible Disconnecting Means:
- a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
1. Pilot Lights and Selector Switches: Heavy-duty type.
 - a. Pilot Lights: LED type; Red when "ON". Green when "OFF (safe)".
 - b. Selector Switches: Rotary type "Hand-Off-Auto (HOA)."
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Install fuses in each fusible-switch enclosed controller.
- C. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

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3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect and test controllers, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection 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. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

3.7 WARRANTY

- A. Warranty: Repair or replace equipment that fail in materials or workmanship within One year from date of Final Completion.

3.8 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Final Acceptance.

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3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

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SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes packaged engine-generator sets for emergency power supply with the following features:

Adjust list below to suit Project.

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted and remote-mounted control and monitoring.
4. Performance requirements for sensitive loads.
5. Fuel system.
6. Parallel generator sets.
7. Load banks.
8. Outdoor enclosure.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquid petroleum.
- C. EPS: Emergency power supply.
- D. EPSS: Emergency power supply system.

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 gallons per hour at 0.5, 0.75 and 1.0 times generator capacity.

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5. Include generator efficiency at 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, 80, 70, 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 kw rating, efficiency, reactances, and short-circuit current capability.
8. Fuel-Tank Capacity Calculation: Demonstrate the fuel tank contains a minimum of 133 percent of total fuel required for the hours of continuous operation for indicated EPSS class

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
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. Only required for seismic certified units.
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.

- C. Coordination Study Report: The findings of the Section 260573 Coordination Study Report (CSR) may affect the overcurrent protective devices and fault-current withstand requirements for switchboards, panelboards, generator breakers and transfer switches. Also, the preparation of the CSR is dependent on the manufacturer's data for this equipment. Therefore, until Submittal final Approval is granted for the CSR, these materials shall be considered at best "Approved, pending Approval of the CSR" and not released for order.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators 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. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to generator location.
 - c. Training plan.
 - d. Warranty.

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1.6 SUBSTITUTIONS

The generator system has been designed to the Basis of Design manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust and other physical and electrical components have all been sized and designed around Caterpillar supplied equipment. Should any other manufacturer's equipment be submitted for use on the project, the equipment provider shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result. Other generator manufacturers are known to produce equipment capable of meeting the functional requirements of this section but have not been evaluated to confirm they are compatible with the space limitations or any other installation requirements that may differ from the Basis of Design Equipment.

1.7 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 One year from date of Final Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Caterpillar; Engine Div.
 - 2. Generac Power Systems, Inc.
 - 3. Kohler Power Systems.
 - 4. Onan/Cummins Power Generation; Industrial Business Group.
 - 5. MTU Onsite Energy
- B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance: Comply with ASME B15.1.
- B. Comply with EPA emission standards for reciprocating internal combustion engines (RICE).
- C. NFPA Compliance:
 - 1. Comply with NFPA 37.
 - 2. Comply with NFPA 70.
 - 3. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

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- D. UL Compliance: Comply with UL 2200.
- E. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.
- F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- G. 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 40 deg C.
 - 2. Altitude: Sea level to 1000 feet.
- H. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:

2.3 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 application.
- C. EPSS Class: Engine-generator set shall be classified as a Class 48 in accordance with NFPA 110.
- D. Governor: Adjustable isochronous, with speed sensing.
- E. 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.
- F. 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. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- G. Generator-Set Performance:

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1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. 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.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.
9. 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.
10. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
11. 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.
12. 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.
13. 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.
14. 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.
15. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
16. Start Time: Comply with NFPA 110, Type 10, system requirements.

H. Parallel Engine Generators (when indicated on the drawings):

1. Automatic reactive output power control and load sharing between generator sets operated in parallel.

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2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

I. Sound Attenuation:

1. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.

2.4 ENGINE

- A. Fuel: Fuel oil, Grade DF-2
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 1. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 2. 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.
 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

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- 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 Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
 7. 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.
 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
 9. 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 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 30.

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- B. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- C. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- D. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
 - 1. Tank level indicator.
 - 2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for the hours of continuous operation for indicated EPSS class.
 - 3. Leak detection in interstitial space.
 - 4. Vandal-resistant fill cap.
 - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 - 6. The tank may extend beyond the footprint of the generator in both wide and length in order to comply with the breaker height requirement in 2.7E below and use the top of the tank as a walkway. Provide a means to access the top of the tank, a slip resistant surface on top of the tank and fall protection as required.

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 generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- C. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration: 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 generator set. Panel shall be powered from the engine-generator set battery.
- F. Indicating Devices: As required by NFPA 110 for Level 1 system, including the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. EPS supplying load indicator.
 - 5. Ammeter and voltmeter phase-selector switches.

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6. DC voltmeter (alternator battery charging).
 7. Engine-coolant temperature gage.
 8. Engine lubricating-oil pressure gage.
 9. Running-time meter.
 10. Current and Potential Transformers: Instrument accuracy class.
- G. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
1. Start-stop switch.
 2. Overcrank shutdown device.
 3. Overspeed shutdown device.
 4. Coolant high-temperature shutdown device.
 5. Coolant low-level shutdown device.
 6. Low lube oil pressure shutdown device.
 7. Air shutdown damper shutdown device when used.
 8. Overcrank alarm.
 9. Overspeed alarm.
 10. Coolant high-temperature alarm.
 11. Coolant low-temperature alarm.
 12. Coolant low-level alarm.
 13. Low lube oil pressure alarm.
 14. Air shutdown damper alarm when used.
 15. Lamp test.
 16. Contacts for local and remote common alarm.
 17. Coolant high-temperature prealarm.
 18. Generator-voltage adjusting rheostat.
 19. Main fuel tank low-level alarm.
 - a. Low fuel level alarm shall be initiated when the level falls below that required for operation for the duration required in "Fuel Tank Capacity" Paragraph in "Diesel Fuel-Oil System" Article.
 20. Run-Off-Auto switch.
 21. Control switch not in automatic position alarm.
 22. Low cranking voltage alarm.
 23. Battery-charger malfunction alarm.
 24. Battery low-voltage alarm.
 25. Battery high-voltage alarm.
 26. Generator overcurrent protective device not closed alarm.
- 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.
- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED 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

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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. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low cranking voltage alarm.
19. Generator overcurrent protective device not closed.

J. 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.

K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. 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.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, type; 100 percent rated; complying with UL 489.

1. All breakers feeding panelboards on the life safety, legally required and optional standby systems shall be LSI (long time, short time and instantaneous) mission critical breakers. Upsize the breaker frame size as required.
2. AIC rating shall match the breaker supplying the ATS from the normal utility supply
3. Tripping Characteristic: Designed specifically for generator protection.
4. Trip Rating: Matched to generator output rating.
5. Mounting: Adjacent to or integrated with control and monitoring panel.

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- 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 generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
 - 1. Trip generator protective device on ground fault.
- E. If output circuit breaker(s) and/or generator controls are located more than 6'-6" above the finished grade and/or are not readily accessible and with clearances as required by the NEC, provide all necessary work and materials including but not limited to ramps, stairs, and platforms required to achieve compliance with the conditions above. All provisions shall conform to OSHA, state and local safety requirements including but not limited to handrails, markings, signage, and access barriers.

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 or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required..
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.
- G. 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.

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2. Maintain voltage within 15 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.9 LOAD BANK (When indicated on the drawings)

- A. Description: Permanent, outdoor, weatherproof, radiator mounted remote-controlled, forced-air-cooled, resistive unit capable of providing a balanced three-phase, delta-connected load to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. Unit shall be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.
- B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and stainless-steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases. Galvanized steel is prohibited. Element's maximum resistance shall be between 100 and 105 percent of rated resistance.
- C. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.
- D. Load-Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
- E. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- F. Load-Bank Enclosures: NEMA 250, Type 3R, aluminized steel complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- square, galvanized-steel mesh. Load bank shall include automatic shutters at air intake and discharge. Components other than resistive elements shall receive exterior epoxy coating with compatible primer.
- G. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000 A interrupting capacity.

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2.10 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: 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.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
 - 3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- C. Enclosure Heater: Electric, factory to comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- D. Provide unit battery powered emergency lighting fixture within the weatherproof enclosure interior

2.11 MOTORS

- A. Description: NEMA MG 1, Design B, medium induction random-wound, squirrel cage motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- E. 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.
- F. Temperature Rise: Match insulation rating.
- G. 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.
- H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

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2.12 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
- B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connectors 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.

2.13 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.14 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Test generator, exciter, and voltage regulator as a unit.
 - 3. Full load run.
 - 4. Maximum power.
 - 5. Voltage regulation.
 - 6. Transient and steady-state governing.
 - 7. Single-step load pickup.
 - 8. Safety shutdown.

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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 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than ten working days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

3.3 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Equipment Mounting:
 - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations."
 - 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. Provide the pad to include the overall footprint of the generator with stair and fuel tank plus 12" on all sides. Coordinate pad opening with the manufacturer. Refer to the detail on the structural drawing for pad construction.
- C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

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3.4 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. 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." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.
- F. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."
- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 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.
- 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 as specified in NETA Acceptance Testing Specification. 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

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- 1) Perform insulation-resistance tests in accordance with IEEE 43.
 - a) Machines larger than 200 horsepower. Test duration shall be 10 minutes. Calculate polarization index.
 - b) Machines 200 horsepower or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
 - 2) Test protective relay devices.
 - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
 - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
 - 5) Conduct performance test in accordance with NFPA 110.
 - 6) 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. Complete the form attached in part 4. A digital copy (PDF or excel) is available from the Architect by request. Include the completed test form in the O& M manual.
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.
8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.

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- 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.
- L. Upon completion of testing, provide a full tank of fuel within all provided fuel tanks.

3.7 WARRANTY

- A. Warranty Period: Provide a warranty to repair or replace for One year from date of Final Acceptance.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

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PART 4 - ATTACHMENTS

NFPA 110 Generator test

1. Cranking test of the battery start system capacity

The battery capacity is validated by disabling the generator, attempting to crank for two complete cycles (total cranking time of 2 x 45 sec), and then starting the generator

Time	Interval	Verified	Notes
	45 sec		Attempt Start #1
	90 sec		Attempt Start #2
	Start unit		Enable unit and Start

2. Building test (90 minutes)

Start the generator, connect all the building loads via the ATS unit(s). Record information below

Time	Interval	Connected KVA	% Load	Volts	Amps A	Amps B	Amps C	RPM	Hz	KVA	KW	PF	Oil Pressure (psi)	Constant temp (F)	Battery Voltage	Fuel Pres (psi)	Ambient Temp (F)
	15 min																
	30 min																
	45 min																
	60 min																
	75 min																
	90 min																

3. Load test (120 minutes)

Connect the load bank and start the generator using any method. Record information below

Time	Interval	Connected KVA	% Load	Volts	Amps A	Amps B	Amps C	RPM	Hz	KVA	KW	PF	Oil	Constant	Battery	Fuel Pres	Ambient
	15 min		30%														
	30 min		30%														
	45 min		50%														
	60 min		50%														
	75 min		100%														
	90 min		100%														
	105 min		100%														
	120 min		100%														

4. Confirm single load step (100%) performance (5 minutes)

Leave the load bank connection transfer 100% load in one step. Record information below

Time	Interval	Connected KVA	% Load	Volts	Amps A	Amps B	Amps C	RPM	Hz	KVA	KW	PF	Oil Pressure (psi)	Constant temp (F)	Battery Voltage	Fuel Pres (psi)	Ambient Temp (F)
	5 min		100%														

END OF SECTION 263213

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SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Nonautomatic transfer switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- C. Qualification Data: For manufacturer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Closeout Procedures," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

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- C. Comply with NEMA ICS 1.
- D. Comply with NFPA 70.

1.5 The transfer switch to be warranted by the manufacturer for a period of five (5) years, from the date of final inspection and acceptance. The warranty shall be included in the contract document. The warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers approved for the use with the generator offering products that may be incorporated into the Work

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Refer to the drawings for the specific requirements of each transfer switch and apply the requirements indicated herein as required. Unless specified otherwise all transfer switches shall be 3 poles,
- B. 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.
- C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008. Where the fault current rating indicated on the drawings is not available in the size indicated, provide the lowest sized equipment that will meet the rating indicated.
 - 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.
- D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

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1. Switch Action: Double throw; mechanically held in both directions.
 2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- D. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- E. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at

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- 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Transfer Switch Control System:
 - a. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be microprocessor-based. The control settings shall be stored in nonvolatile memory.
 - b. The control module shall have a three-position, key-operated, programming control switch. The key shall be removable in any position. The positions shall be:
 - 1) Off - Allows all enabled accessories to be monitored only. Settings cannot be changed while in this position.
 - 2) Local - Allows all enabled accessory settings to be changed locally at the transfer switch control panel
 - 3) Remote - Allows all enabled accessories to be altered via the remote communications port.
 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.
 8. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 9. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 10. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac. One set of contacts shall be used by the BAS to indicated the status of the switch as described in specification section 230993.
 11. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

2.4 NONAUTOMATIC TRANSFER SWITCHES

- A. Non Automatic Transfer switches shall only be provided where specifically indicated on the drawings.
- B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable 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.
- C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- D. Nonautomatic Transfer-Switch Accessories:

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1. Pilot Lights: Indicate source to which load is connected.
 2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
 3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.
- E. External connections: Lugs sized to accept up to three 600KCM cables per phase. Solid neutral connection shall be to same size as the phase connections. Ground connect as required by NEMA and NEC.

2.5 SERVICE ENTRANCE RATED TRANSFER SWITCHES

- A. Where indicated on the drawing, provide equipment that is UL listed and tested for use as service entrance equipment. Provide an integral breaker in the equipment to disconnect the normal power source.
- B. Arc Energy Reduction. Where the highest continuous current trip setting of a circuit breaker is rated or can be adjusted to is 1200 A or higher.
 1. Provide one of the following methods to reduce clearing time
 - a. Zone-selective interlocking
 - b. Differential relaying
 - c. Energy-reducing maintenance switching with local status indicator
 - d. Energy-reducing active arc flash mitigation system
 2. Indicate the method of compliance in the submittals
 3. Provide documentation how the breaker is authorized to be installed, operated, and/or inspected
 4. Contractor shall adhere to the documentation and post the information at the location of the circuit breaker(s).

2.6 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identify components according to Division 26 Section "Identification for Electrical Systems."
- B. Set field-adjustable intervals and delays and relays.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. 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.
 - 4. ATS testing: After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.

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- d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. MTS Testing: Demonstrate interlocking sequence and operational function for each switch.
- a. The owner will provide a portable generator for testing. Notify the owner at least ten business day prior to the scheduled test. The contractor shall pay for the fuel for testing.
 - b. Connect the portable generator to the MTS, turn off the all the breakers in the panel connected to the MTS, energized the emergency source and transfer the load to the portable generator sequentially by closing the breakers in the panel connected to the MTS and monitoring connected load on the panelboard meter. If the entire load of the panel cannot be supported by the portable generator, demonstrate that all the loads are capable of being supplied by the generator by manually operating the breakers in the panel and monitoring the meter for the panel.
 - c. Should any portion of the system fail testing, the contractor shall bear the cost of correcting the failure and renting a generator for retesting.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Closeout Procedures."

3.5 WARRANTY

- A. Warranty Period: Provide a warranty to repair or replace for One year from date of Final Acceptance.

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 for structures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Ground loop conductor.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.
- B. System Certificate:
 - 1. UL Master Label.
 - 2. UL Master Label Recertification (if an existing building)
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

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1.5 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780,
 - 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. Advanced Lightning Technology, LTD.
 - b. East Coast Lightning Equipment Inc.
 - c. ERICO International Corporation.
 - 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
 - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.
- C. Main and Bonding Conductors: Aluminum.
- D. If structures exceeding 60 feet provide a Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.

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- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
 - C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade within 200 feet of building.
 - D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.
 - E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
 - F. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.
 - G. Ground Loop (If required): Install ground-level, potential equalization conductor and extend around the perimeter of structure.
 - 1. Bury ground ring not less than 24 inches from building foundation.
 - 2. Bond ground terminals to the ground loop.
 - 3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.
 - H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.
- 3.2 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."
- 3.3 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 cause deterioration or corrosion of conductors.

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3.4 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 264113

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SECTION 264313 - SUPPRESSION PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
 - 1. Division 26 Section "Panelboards" for factory-installed SPD.
 - 2. Division 26 Section "Wiring Devices" for devices with integral SPD.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. SPD: Surge Protection Device, both singular and plural; also, transient voltage surge suppression. Where TVSS is used in the Contract Documents, it shall be construed to mean SPD Surge Protective Device(s).

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Product Certificates: For SPD devices, from manufacturer.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For SPD devices to include in emergency, operation, and maintenance manuals.
- E. Warranties: Sample of special warranties.

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1.5 PROJECT CONDITIONS

- A. Service Conditions: Rate SPD devices for continuous operation under the following conditions unless otherwise indicated:
1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 3. Humidity: 0 to 85 percent, noncondensing.
 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.6 COORDINATION

- A. Coordinate location of field-mounted SPD devices to allow adequate clearances for maintenance.
- B. Coordinate SPD devices with Division 26 Section "Electrical Power Monitoring and Control."

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period of five years from date of **Final Acceptance**

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advanced Protection Technologies Inc. (APT).
 2. Current Technology Inc.; Danaher Power Solutions.
 3. Danaher Power Solutions; United Power Products.
 4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 6. Liebert Corporation; a division of Emerson Network Power.
 7. Northern Technologies, Inc.; a division of Emerson Network Power.
 8. Siemens Energy & Automation, Inc.
 9. Square D; a brand of Schneider Electric.
 10. Surge Suppression Incorporated.
- B. Surge Protection Devices:
1. Comply with UL 1449 latest edition.
 2. IEEE C62.41 Category C device.
 3. Fabrication using bolted compression lugs for internal wiring.

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4. Integral disconnect switch.
5. Redundant suppression circuits.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.

D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2.

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V.
2. Line to Ground: 800 V for 480Y/277 V.
3. Neutral to Ground: 800 V for 480Y/277 V.

F. The SPD equipment shall have the following noise filtering levels

Frequency	100 kHz	1 MHz	10 MHz	100MHz
Noise Filtering Level	34 dB	51dB	54 dB	48 dB

G. SPD units shall be mounted integral with the main distribution switchboard MDS and emergency distribution switchboard EDS, and listed for use with the equipment provided.

2.2 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advanced Protection Technologies Inc. (APT).
2. Current Technology Inc.; Danaher Power Solutions.
3. Danaher Power Solutions; United Power Products.
4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
6. Liebert Corporation; a division of Emerson Network Power.
7. Northern Technologies, Inc.; a division of Emerson Network Power.
8. Siemens Energy & Automation, Inc.
9. Square D; a brand of Schneider Electric.

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10. Surge Suppression Incorporated.

B. Surge Protection Devices:

1. Comply with UL 1449 second edition.
2. IEEE C.62.41 Category B device.
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant suppression circuits.
7. Redundant replaceable modules.
8. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
9. LED indicator lights for power and protection status.
10. Audible alarm, with silencing switch, to indicate when protection has failed.
11. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
12. Transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.

D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 V or 400 V for 208Y/120 V.
2. Line to Ground: 800 V for 480Y/277 V or 400 V for 208Y/120 V.
3. Neutral to Ground: 800 V for 480Y/277 V or 400 V for 208Y/120 V.

F. SPD unit shall be mounted integral with the panelboard served, and listed for use with the equipment provided or enclosure shall be NEMA 250, with type matching the enclosure of panel or device being protected. The enclosure shall be suitable for the location in which it is installed, indoors or outdoors. Install the SPD unit as close as possible to the equipment served. Provide a 3-pole circuit breaker or fuse in the equipment to serve as a SPD disconnect means.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

B. Outdoor Enclosures: NEMA 250 Type 3R.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multi pole, 60-A circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- C. SPD device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment or panelboards to their sources until SPD devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests and reconnect immediately after the testing is complete.

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3.4 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fail in materials or workmanship within One year from date of Final Completion.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPD devices.

END OF SECTION 264313

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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. Interior solid-state luminaires that use LED technology.
 - 2. Exit Signs
 - 3. Lighting fixture supports.

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.

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7. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.

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.

C. Product Schedule: For luminaires. Use same designations indicated on Drawings.

D. For each fixture provide a color palette of the manufacturer's full color offering. Indicate which colors are standard (no additional cost) and which are custom (additional cost). Architect shall pick the color of all fixtures at the time of the submittal.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within Five years from date of Final Completion.

1.8 EXTRA MATERIALS

A. Provide extra materials described below that match products installed including installation. Uninstalled devices shall be packaged with protective covering for storage, identified with labels describing contents and turned over to the owner at the completion of the project.

1. Ballasts/Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
3. Exit signs: Provide 10% of total count but not less than 10 additional exit signs (single face or double face, as needed)

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4. Including 100' of conduit, boxes, wire, associated accessories and installation for each unit listed above. Units shall be installed as directed by the Architect, Owner, or Authority Having Jurisdiction (AHJ).

1.9 SUBSTITUTIONS

- A. The lighting fixture layout indicated in the Contract Documents is based upon photometric data, quality, construction and appearance of fixtures listed in the lighting fixture schedule. Substitutions of listed fixtures are allowed provided the following is provided:
 1. Substitution package shall be submitted to Architect no later than ten (10) days prior to bid for review and approval.
 2. Provide all data for the substitution package in a table similar in format to the lighting fixture schedule on the drawings.
 3. Provide cut sheets of substitute fixtures with the various features highlighted.
 4. Architect has final functional and aesthetic approval on all substituted fixtures.
 5. Pre-bid approved will still be subject to the usual post bid submittal process and review.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. All interior LED lighting fixtures shall be compliant with current product requirements of Design Lighting Consortium (DLC) or ENERGY STAR program.
- C. Recessed Fixtures: Comply with NEMA LE 4.
- D. Bulb shape complying with ANSI C79.1.
- E. CRI of minimum 80 CCT of 4100K.
- F. Rated lamp life of 50,000.
- G. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- H. Internal driver:
 1. Minimum efficiency: 85% at full load.
 2. Minimum Operating Ambient Temperature: -20° C. (-4° F.).
 3. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 4. Integral short circuit, open circuit, and overload protection.
 5. Power Factor: ≥ 0.95.
 6. Total Harmonic Distortion: ≤ 20%.
 7. Comply with FCC 47 CFR Part 15.

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- I. LED Modules:
 - 1. Comply with IES LM-79 and LM-80 requirements.
 - 2. Minimum CRI 80 and color temperature 4200° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - 3. Minimum Rated Life: 50,000 hours per IES L70.
 - 4. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- J. Nominal Operating Voltage: Provide Universal voltage (MVOLT) ballast where possible. Otherwise provide per the drawings.
- K. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- L. Housings:
 - 1. Extruded-aluminum or steel housing and heat sink.
 - 2. Powder-coat painted finish.

2.2 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 - 2. Battery Powered Exit Signs: Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.3 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.

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- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 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.

2.5 LUMINAIRE FIXTURE 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. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- 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.

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- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. 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. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 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.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch diameter aircraft cable supports attached to structure. Do not attached to ceiling with no additional support.
- H. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

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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.

I. Ceiling-Grid-Mounted Luminaires:

1. Lighting fixtures: Set level, plumb, and square with ceilings and walls.
2. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings.
 - a. Do not use grid alone to at support element.
 - b. Install a minimum of two support system rods or wires for each fixture located no more than 6 inches (150 mm) from lighting fixture corners diagonally across the fixture.
 - c. Wire or rod shall have a minimum strength factor of the weight of fixture at a safety factor of 3.
 - d. Secure luminaire to the luminaire opening using approved fasteners in a minimum of two locations, spaced near diagonal corners of luminaire.
3. Fixtures of Sizes Less Than Ceiling Grid:
 - a. Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
 - b. Fixtures larger than 18"x18" shall also be supported by a minimum of two support system rods or wires for each fixture located no more than 6 inches (150 mm) from lighting fixture corners diagonally across the fixture.

- J. 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 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

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END OF SECTION 265119

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SECTION 265613 - LIGHTING POLES AND STANDARDS

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. Poles and accessories for support of luminaires.
 - 2. Luminaire-lowering devices.

1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Include finishes for lighting poles and luminaire-supporting devices.
 - 3. Anchor bolts.
 - 4. Manufactured pole foundations.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, 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. Detail fabrication and assembly of poles.
 - 4. Anchor bolt templates keyed to specific poles and certified by manufacturer.

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5. Method and procedure of pole installation. Include manufacturer's written installations.
6. Color palette of the manufacturer's full color offering. Indicate which colors are standard (no additional cost) and which are custom (additional cost).

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on poles until right before pole installation. Handle poles with web fabric straps.

1.7 WARRANTY

1. Warranty Period: Five years from date of Final Completion.

PART 2 - PRODUCTS

2.1 STEEL POLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products shall be as indicated on the drawings.
- B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
- C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
 1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

Indicate span and rise of mast arms in "Steel Mast Arms" Paragraph below on Drawings. Delete paragraph if mast arms are adequately described in the Exterior Lighting Device Schedule or in details on Drawings.

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- D. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless or galvanized-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Fasteners: Stainless steel or Galvanized steel size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- I. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- J. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
- K. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- L. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- M. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces according to 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, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. 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.
- N. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

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1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder Coat: Comply with AAMA 2604.
 - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.

2.2 ALUMINUM POLES

- A. Subject to compliance with requirements, provide products as indicated on the drawings.
- B. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6063-T6, with access handhole in pole wall.
- C. Mast Arms: Aluminum Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless or galvanized-steel bolts.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Fasteners: Stainless steel or Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- J. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

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1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
- K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 3. 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.
- L. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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 powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Powder coat shall comply with AAMA 2604.
 - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.

2.3 FIBERGLASS POLES

See editor's notes for discussion on pole flexure and vibration.

- A. Manufacturers: Subject to compliance with requirements, provide products as indicated on the drawings.
- B. Poles:
1. Designed specifically for supporting luminaires, with factory-formed cable entrance and handhole.
 2. Not less than 65 percent by weight of fiberglass roving, with resin and pigment making up the remainder.
 3. Roving shall be continuously applied with uniform tension, with multiple layers placed to meet axial and compressive strength requirements.
 4. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
 5. Resin Color: Uniform coloration throughout entire wall thickness.

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6. Surface Finish: Smooth and uniform along surface of pole.
 7. Paint Finish: Pigmented polyurethane, with a minimum dry film thickness of 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently UV inhibited.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded within fiberglass roving, allowing the bracket to be bolted to the pole-mounted adapter. Bolt together with [stainless] [galvanized]-steel bolts; use anti-seize compound when bolting dissimilar metals.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- D. Pole-Top Tenons: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded to the fiberglass shaft. Fabricated to support luminaire or luminaires and brackets indicated.
- E. Fasteners: Stainless steel or Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- G. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. Anchor Base: Integral galvanized steel or aluminum casting, enclosing and permanently bonded to the exterior of the fiberglass shaft.
- 2.4 MOUNTING HARDWARE
- A. Anchor Bolts: Manufactured to with a minimum yield strength of 55,000 psi.
1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C
 2. Bent Headed rods sized per manufacturer.
 3. Threading: Uniform National Coarse, Class 2A.
- B. Nuts and Washers
1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C
 2. Minimum Two nuts provided per anchor bolt

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2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
 - 1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.

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- D. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
1. Make holes 6 inches in diameter larger than pole diameter.
 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
 3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
 4. Cure concrete a minimum of 72 hours before performing work on pole.

3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
1. Fire Hydrants and Water Piping: 60 inches.
 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
 3. Trees: 15 feet from tree trunk.
- C. Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 3. Install base covers unless otherwise indicated.
 4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

Retain "Poles and Pole Foundations Set in Concrete-Paved Areas" Paragraph below for projects in seismic areas, to minimize possible concentration of horizontal forces during seismic events where poles or pole foundations meet the finished grade.

- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

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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 using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in 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 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following special inspections:
 - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
 - 2. System function tests.

END OF SECTION 265613

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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. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

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,
6. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

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7. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.

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.

C. Product Schedule: For luminaires. Use same designations indicated on Drawings.

D. For each fixture provide a color palette of the manufacturer's full color offering. Indicate which colors are standard (no additional cost) and which are custom (additional cost). Architect shall pick the color of all fixtures at the time of the submittal.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires [and photoelectric relays] to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

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.

1.9 EXTRA MATERIALS

A. Provide extra materials described below that match products installed including installation. Uninstalled devices shall be packaged with protective covering for storage, identified with labels describing contents and turned over to the owner at the completion of the project.

1. Ballasts/Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

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2. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
3. Including 100' of conduit, boxes, wire, associated accessories and installation for each unit listed above. Units shall be installed as directed by the Architect, Owner, or Authority Having Jurisdiction (AHJ).

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- B. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within Five years from date of Final Completion.

1.11 SUBSTITUTIONS

- A. The lighting fixture layout indicated in the Contract Documents is based upon photometric data, quality, construction and appearance of fixtures listed in the lighting fixture schedule. Substitutions of listed fixtures are allowed provided the following is provided:
 1. Substitution package shall be submitted to Architect no later than ten (10) days prior to bid for review and approval.
 2. Provide all data for the substitution package in a table similar in format to the lighting fixture schedule on the drawings.
 3. Provide cut sheets of substitute fixtures with the various features highlighted.
 4. Architect has final functional and aesthetic approval on all substituted fixtures.
 5. Pre-bid approved will still be subject to the usual post bid submittal process and review.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

Coordinate "FM Global Compliance" Paragraph below with Drawings.

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- 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. CRI of minimum 70 CCT of 4100 K
- F. L70 lamp life of 50,000 hours.
- G. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: Provide Universal voltage (MVOLT) ballast where possible. Otherwise provide per the drawings.
- J. Source Limitations: 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 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 Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. 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.

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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.

PART 3 - EXECUTION

3.1 SITE LIGHTING

- A. Exterior site lighting is being provided by the Power company. Coordinate the pole locations with the power company and adjust as required. Contact the power company to coordinate the lighting installation. Provide a minimum of 120 day notice prior to the needed install to allow for material procurement.

Contact information.

Greg Mobley
gregmobley@fourcty.org
Office 910-259-1855
888-368-7289
Cell 910-271-4107
Fax 910-259-1817

Jimmy Smith
jimmysmith@fourcty.org
Office 910-259-1821

3.2 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, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 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.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.

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- 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. Install luminaires at height and aiming angle as indicated on Drawings.
 - I. Coordinate layout and installation of luminaires with other construction.
 - J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
 - K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.
- 3.5 BOLLARD LUMINAIRE INSTALLATION:
- A. Align units for optimum directional alignment of light distribution.
 - B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.
- 3.6 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES
- A. Aim as indicated on Drawings.
 - B. Install on concrete base with top [4 inches] <Insert dimension> above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

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3.7 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.

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
 - 3. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 QUALITY ASSURANCE

- A. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment".
- B. The Division 27 contractor shall have a minimum of 5 years of experience with communication sites, Motorola R56, and TIA 607.**
- C. All grounding and bonding must comply with Motorola R56 and TIA 607.**

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 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:

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- a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 3. Pressure Plates: Carbon steel with corrosion and rust-resistant coating . Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 SECURITY FASTENERS:

- A. Description: Accessories, anchorage inserts, and security fasteners providing a complete tamperproof installation.
- B. Exposed Security Fasteners:
 1. Fastener: Provide **torx-head** (star with center reject pin) security fasteners for anchoring work in exposed security areas.
 2. Finish: Finish shall match that specified of the item anchored.
 3. Tools: Provide tools for fastening devices.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 SECURITY FASTENERS

- A. All fasteners exposed in security areas shall be security fasteners. Where standard fasteners on manufactured devices and equipment are accessible, they shall be replaced with security fasteners.

END OF SECTION 270500

SECTION 270526 - GROUNDING AND BONDING 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.
- B. See Division 26 specification section.
- C. Motorola R56 Standards and Guidelines for Communication Sites
- D. TIA 607

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding bus bars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding bus bar.
- D. TMGB: Telecommunications main grounding bus bar.
- E. RBB: Rack Bonding Bar
- F. EGB: External Bonding Bar

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. BCT, TMGB, TGBs, RBBs, EGBs and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agencies field supervisor.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by B I C S I as a registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-D.
- B. Comply with Motorola R56 Standards and Guidelines for Communication Sites
- C. Comply with TIA 607

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning and Grounding.
 - 2. Panduit Corp.
 - 3. Tyco Electronics Corp.
 - 4. Approved Equal
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG 26 kcmils (13.3 sq. mm) and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a two-hole irreversible 2-ton rated crimp of tin plated copper material. If jumper is a flexible, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer. Braided jumpers are not permitted.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

- A. Two-hole irreversible crimp 2-ton rated crimp of tin plated copper material. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Chatsworth Products, Inc.
 - 3. Harger Lightning and Grounding.
 - 4. Panduit Corp.
 - 5. Tyco Electronics Corp.
 - 6. Approved Equal
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Pedestal Clamps: Tin plated copper alloy with stainless-steel hardware laid in a bidirectional cross-pattern. Split bolts are not permitted.
- F. Bus bar Connectors: Cast silicon bronze, solderless exothermic -type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the bus bar.
- G. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning and Grounding.
 - 3. Panduit Corp.
 - 4. Approved Equal

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- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches by 24 inches (6.3 by 100 mm by 600 mm in cross section, length as indicated on Drawings. The bus bar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-D.
1. Pre-drilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide a 4-inch ((100-mm clearance to access the rear of the bus bar. Brackets and bolts shall be stainless steel.
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The bus bar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-B.
1. Pre-drilling shall be with holes for use with lugs specified in this Section.
 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50-mm) clearance to access the rear of the bus bar. Brackets and bolts shall be stainless steel.)
 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Bus bars: 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 J-STD-607-B. Pre-drilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Bus bar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 2. Rack-Mounted Horizontal Bus bar: Designed for mounting in 19- or 23-inch (483- or 584-mm) 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 Bus bar: 72 or 36 inches ((1827 or 914 mm) long, with)stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Harger Lightning and Grounding.
 2. Tyco Electronics Corp.
 3. Approved Equal
- B. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).

2.6 LABELING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brother International Corporation.
 - 2. HellermannTyton.
 - 3. Panduit Corp.
 - 4. Approved Equal
- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac 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 the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-D.
- D. Comply with Motorola R56 Standard for Communication Sites

- E. Comply with TIA 607

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.
- C. 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.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch (900-mm) intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 4/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding bus bars on Drawings. Install bus bars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) 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.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding bus bar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 4/0 AWG 168 kcmils (85 sq. mm) unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

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- H. Electrical Power Panel boards: Where an electrical panel board for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panel board.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-C.1 and TIA/EIA-568-C.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.
- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
 - 4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
 - 6. Waveguides and Coaxial Cable:

- a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
- b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductor's level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

- C. Tests and Inspections:
1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the bus bar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

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. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.
2. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, hand holes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For wire ways, nonmetallic wire ways, and surface pathways and for each color and texture specified, 12 inches (300 mm) long.
- D. Quality Assurance: All field design submittals for Div. 27 specifications shall be done by an RCDD or under the guidance of an RCDD.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Alpha Wire Company.
 - 4. Anamet Electrical, Inc.
 - 5. Electri-Flex Company.
 - 6. O-Z/Gedney.
 - 7. Picoma Industries.
 - 8. Republic Conduit.
 - 9. Robroy Industries.
 - 10. Southwire Company.
 - 11. Thomas & Betts Corporation.
 - 12. Western Tube and Conduit Corporation.
 - 13. Wheatland Tube Company.
 - 14. Approved Equal

- B. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated IMC
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 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 (1 mm), with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: :
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Arnco Corporation.

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5. CANTEX Inc.
6. CertainTeed Corporation.
7. Condux International, Inc.
8. Electri-Flex Company.
9. Kraloy.
10. Lamson & Sessions; Carlon Electrical Products.
11. Niedax-Kleinhuis USA, Inc.
12. RACO; Hubbell.
13. Thomas & Betts Corporation.
14. Approved Equal

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-C.

C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

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

1. Alpha Wire Company.
2. Aruco Corporation.
3. Endot Industries Inc.
4. IPEX.
5. Lamson & Sessions; Carlon Electrical Products.
6. Approved Equal

- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-C.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Mono-Systems, Inc.
 - 4. Square D.
 - 5. Approved Equal
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 4 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wire ways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-C.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wire way Covers: Flanged-and-gasketed type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
 - 5. Approved Equal
- B. General Requirements for Nonmetallic Wire ways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-C.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-C.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
 - e. Approved Equal
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's

standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lamson & Sessions; Carlon Electrical Products.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Quazite:Hubbell Power Systems, Inc.
 - e. Wiremold / Legrand.
 - f. Approved Equal

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. Hoffman.
 6. Lamson & Sessions; Carlon Electrical Products.
 7. Milbank Manufacturing Co.
 8. Molex; Woodhead Brand.
 9. Mono-Systems, Inc.
 10. O-Z/Gedney.
 11. Quazite:Hubbell Power Systems, Inc.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
- B. Approved Equal - General Requirements for Boxes, Enclosures, and Cabinets:
 1. Comply with TIA-569-C.
 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

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- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- F. Metal Floor Boxes:
 - 1. Material: Cast metal or sheet metal.
 - 2. Type: Fully adjustable
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: 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.

- 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 galvanized, or cast iron with gasketed cover.

- I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)

- J. Gangable boxes are allowed

- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4 with continuous- hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Fiberglass .
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

- M. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panel boards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND COMMUNICATION CABLING

A. General Requirements for Handholes and Boxes:

1. Boxes and hand holes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Comply with TIA-569-C.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc; Christy Concrete Products.
 - e. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.
 - f. Synertech Moulded Products.
 - g. Approved Equal
3. Standard: Comply with SCTE 77.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and hand hole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "COMMUNICATIONS."
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Dimensions: 24 Inches Wide by 36 Inches Long.

C. Fiberglass Hand holes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Nordic Fiberglass, Inc.

- e. Oldcastle Precast, Inc; Christy Concrete Products.
- f. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.
- g. Synertech Moulded Products.
- h. Approved Equal

- 3. Standard: Comply with SCTE 77.
- 4. Color of Frame and Cover: Gray
- 5. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- 6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and hand hole location.
- 7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 8. Cover Legend: Molded lettering, "COMMUNICATIONS."
- 9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 10. Dimensions: 24 Inches Wide by 36 Inches Long.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Hand hole and Pull-Box Prototype Test: Test prototypes of hand holes 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.

2.10 FIRESTOP FLOOR AND WALL PENETRATIONS

- A. See specifications in Division 26.

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: IMC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased .
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT

3. Exposed and Subject to Severe Physical Damage: GRC
 - 1 Pathway locations include the following:
 - a All spaces within the secure perimeter
 - b Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT
 5. Damp or Wet Locations: GRC
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT
 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT
 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT
 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations. Minimum Pathway Size: 1-inch (21-mm) trade size. Minimum size for optical-fiber cables is 2 inch (27 mm).
- C. 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.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-C for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

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- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) 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 (3-m) intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from EMT to GRC or before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. 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.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. 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.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. 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.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

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- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. 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 (50-mm) radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) 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.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 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.
- T. 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.
- U. 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.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25

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- feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
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 (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) 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 (0.06 mm per meter of length of straight run per deg C) 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 (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. 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.
- Y. 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.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. 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.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

B. Concrete Encased Duct banks

1. See duct bank details on drawings.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install hand holes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install hand holes with bottom below frost line, 24" below grade.
- E. 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.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 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."

3.6 FIRESTOPPING

- A. Install fire stopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Fire stopping."

3.7 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

SECTION 270536 - CABLE TRAYS FOR TELECOMMUNICATION 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. Single-Rail Cable Trays
 - 2. Ladder cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 SINGLE-RAIL CABLE TRAYS

- 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. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. MonoSystems, Inc.
 3. MP Husky USA Cable Tray & Cable Bus.
- B. Description:
1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
 2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
 3. Rung Spacing: 12 inches o.c.
 4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 5. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.

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6. Width: 12 inches unless otherwise indicated on Drawings.
7. Support Point: Splice fittings shall be hanger support point.
8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
9. Loading Depth: 4 inches.
10. Maximum Loads: 50 lb/ft..
11. Maintaining cable tray rungs within six degrees of horizontal is for aesthetic reasons. The tray looks uneven when tilted more than this. Support variations are available to allow varying levels of unbalanced loads while not exceeding the maximum tilt.
- 12.
13. Splicing Assemblies: Bolted type using serrated flange locknuts.
14. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
15. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.
16. Material: Aluminum
 - a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
 - b. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
 - c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.4 LADDER CABLE TRAYS

- 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. Cooper B-Line, Inc.; a division of Cooper Industries.
2. MonoSystems, Inc.
3. MP Husky USA Cable Tray & Cable Bus.

- B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: 12 inches o.c.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: 6 inches.
8. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
9. Width: 12 inches unless otherwise indicated on Drawings.
10. Provide 24 inch wide cable tray in IT closets.
11. Fitting Minimum Radius: 12 inches.
12. Class Designation: Comply with NEMA VE 1, Class 12B.

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13. Splicing Assemblies: Bolted type using serrated flange locknuts.
14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
15. Material: Steel
 - a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
 - b. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
 - d. Finish: Mill galvanized before fabrication.
 - 1) Standard: Comply with ASTM A 653/A 653M, G90.
 - 2) Hardware: Chromium-zinc plated, ASTM F 1136.

2.5 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.
 - a. Standard: Comply with ASTM A 653/A 653M, G90.
 - b. Hardware: Chromium-zinc plated, ASTM F 1136.

2.6 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.7 WARNING SIGNS

- A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA VE 2.
- B. Provide ladder cable tray in all data rooms and single rail cable trays throughout all other spaces cable tray is shown on drawings.
- C. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- D. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- E. Remove burrs and sharp edges from cable trays.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

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- N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- O. Make changes in direction and elevation using manufacturer's recommended fittings.
- P. Make cable tray connections using manufacturer's recommended fittings.
- Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- S. Install cable trays with enough workspace to permit access for installing cables.
- T. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- U. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- W. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.

- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536

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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 apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for conduits that serve communication cabling.
2. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits that serve communication cabling.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
1. For each data room, security electronics room, telephone room or similar communications equipment room. provide plans detailing the layout of the room utilizing the dimensions of the actual equipment to be supplied. Provide elevations, sections, details, and

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attachments to supplement the plans as required to ensure the installation is coordinated with the work of other trades.

2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
4. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A. Requirements of this standard include but are not limited to minimum 1/8" per foot slope for drainage of underground communication ductbank conduits; coordinate with Division 26 conduit installation.
- C. Grounding: Comply with ANSI-J-STD-607-A.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 4. Adjust arrangements 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 the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

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PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
- C. Cable Trays:
 - 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. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope - Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
 - 2. Cable Tray Materials: Basket type metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

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2.3 EQUIPMENT FRAMES

A. General Frame Requirements:

1. Server room Distribution Frames: Freestanding, 42U floor mounted modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 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 preferred manufacturers and model numbers:
 - 1) Vertiv: VR3300
 - 2) AMCO: Titan D.
2. IDF Distribution Frames: Freestanding 42U two post, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 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 preferred manufacturers and model numbers:
 - 1) Legrand: MM20706-B
 - 2) Legrand: R2-44S
3. Finish: Manufacturer's standard, baked-polyester powder coat. Modular-type, aluminum construction.
4. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.

B. Cable Management for Equipment Frames:

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.

C. Patch Panel:

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 preferred manufacturers and model numbers:
 - 1) Patchbox :Plus+Cat 6a
2. Modular panels housing multiple-numbered jack units with retractable IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

2.4 POWER STRIPS

- 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 preferred manufacturers and model numbers:

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1. Vertiv: VP73001
2. Vertiv: VP73002

B. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Multiple 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
5. Cord connected with line cord.
6. Peak Single-Impulse Surge Current Rating: 33 kA per phase.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Grounding Busbar (TMGB and TMG):

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick as detailed on drawing E4.1.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

A. Comply with TIA/EIA-606-A 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 ENTRANCE FACILITIES

- A. The facility will need a multiple communication service entrances as indicated on the electrical site plan. ATT, Spectrum and FOCUS Broadband are aware of this need. Coordinate the installation with the utilities prior to construction.
- B. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- C. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

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- 3.2 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."INSTALLATION
- A. Comply with NECA 1.
 - B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
 - C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- 3.3 FIRESTOPPING
- A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."
 - B. Comply with BICSI TDMM, "Firestopping Systems" Article.
- 3.4 GROUNDING
- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
 - B. Comply with ANSI-J-STD-607-A.
 - C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
 - D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.
- 3.5 IDENTIFICATION
- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
 - B. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271500 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Optical fiber cabling.
 - 2. Cable connecting hardware, patch panels, and cross-connects.
 - 3. Telecommunications outlet/connectors.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- F. Outlet/Connectors: A connecting device in the work area on which cable or outlet cable terminates.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unshielded twisted pair.

1.4 CABLING DESCRIPTION

- A. Cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-E requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

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2. cabling shall contain no more than one transition point or consolidation point between the cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splice shall not be installed in the cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. The maximum allowable cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the cross-connect.

1.5 SUBMITTALS

A. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
4. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.7 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.

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1.8 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Patch-Panel Units: 20% of project total of each type.
 - 2. Connecting Blocks: 20% of project total of each type.
 - 3. Device Plates: 20% of project total of each type.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE

- 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. Berk-Tek; a Nexans company.
 - 2. CommScope, Inc.
 - 3. Corning Cable Systems.
 - 4. Superior Essex Inc.
- B. Description: OS2 Singlemode and/or OM4 multimode, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - 4. Conductive cable shall be armored type.
 - 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 - 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
 - 7. Laser optimized optical fiber cable
- C. Jacket:
 - 1. Jacket Color: Orange or Blue.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.

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3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.2 OPTICAL FIBER CABLE HARDWARE

- 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. ADC.
 2. American Technology Systems Industries, Inc.
 3. Berk-Tek; a Nexans company.
 4. Corning Cable Systems.
 5. Dynacom Corporation.
 6. Hubbell Premise Wiring.
 7. Molex Premise Networks; a division of Molex, Inc.
 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Optical Connectivity Solutions Division; Emerson Network Power.
 10. Siemon Co. (The).
- B. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths. Provide one per pair of fiber indicated on drawings.
- C. Cable Connecting Hardware:
 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex and duplex, connectors. Insertion loss not more than 0.75 dB.
 3. Type SC connectors may be used in termination racks, panels, and equipment packages.

2.3 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
 1. Faceplate: Four port Stainless Steel.
 2. For use with snap-in jacks accommodating any combination of UTP jacks.
 3. Legend: Clear-labels.
 4. Provide blank in un-used openings.

2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

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- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in all spaces whether plenum or not.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Do not use consolidation point as a cross-connect point,.

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4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. 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.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

D. Open-Cable Installation:

1. Install cabling with and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-B for separating unshielded copper voice and data 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 (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

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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 (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and 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 (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

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3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Cable Schedule: Post in 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, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) 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 device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 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 being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - 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.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

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F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect optical fiber cable 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/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

3)

4. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.

5. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

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- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 271500

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 270526 "Grounding and Bonding for Communication Systems"

1.2 SUMMARY

A. Section Includes:

- 1. UTP cabling.
- 2. Cable connecting hardware, patch panels, and cross-connects.
- 3. Telecommunications outlet/connectors.
- 4. Cabling system identification products.
- 5. Cable management system.

B. Related Requirements:

- 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
- 2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

C. All cable types shall be CMP or MPP plenum rated.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point (CP): A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.

- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications' outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit product data for all UTP cabling, patch panels, faceplates, jacks, fiber shelves, termination blocks, equipment cords, patch cords, labeling components, and miscellaneous accessories for all cabling and connectivity.
 - 1. For cable, include the following data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
 - d. Color coding.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 4. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
- C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 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.

1.9 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 Registered 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.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. All telecommunication type cabling (UTP) installed under this contract shall be wholly manufactured and assembled in the United States of America. Wholly or partially manufactured cable or cabling assembly from any other country shall NOT be allowed and entire cabling solution shall be removed, replaced and retested at contractor's expense.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.11 WARRANTY

- A. Materials shall have a minimum of 25-year warranty after acceptance by Owner.
- B. Warranty shall include all labor, material, and travel time.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. UTP cabling shall be premium CAT 6A with capability for 1 Gbps data transmission speed over Ethernet protocol.
- B. Approved premium cabling (Manufacturer's best CAT 6A cable, minimally compliant CAT 6A will not be approved: submit for approval prior to bid) and connectivity systems manufacturers for this project are:
 - 1. **Basis of Design: Panduit**
 - 2. Commscope Systemax.
 - 3. Tyco.
 - 4. Belden.
 - 5. Leviton
 - 6. BerkTek
- C. Description: 100-ohm, four-pair UTP, formed into 4-pair, groups covered with a colored thermoplastic jacket. See color coding for various uses on drawings.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-C.1 for performance specifications.
 - 3. Comply with ANSI/TIA/EIA-568-C.2-10568-C.2, Category 6A.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70.
- D. Communications Plenum Rated: Type CMP or MPP, complying with NFPA 262.
- E. Color Coding: All CAT 6A horizontal cable serving the equipment, patch cords, equipment cords, and jacks shall conform to the following color coding (verify color coding with Owner):
 - 1. Standard Data: Blue
 - 2. Wireless Access Points: Gray.
 - 3. Building Automation HVAC & Controls: Orange.

4. Lighting: Yellow.
 5. AV: Blue.
 6. Security, access controls, camera: Refer to Div 28 specifications.
- F. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 2. Bridged taps and splices shall not be installed in the horizontal cabling.
- G. The maximum allowable horizontal cable length shall be 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.
- H. Install service loops at both ends of each data and voice cable as follows:
1. Tel/data outlet: 1 meter in length at underfloor boxes in access floor (except 4 meters in EOC area) and 1 meter above wall mounted boxes (at conduit stubbed into accessible ceiling space).
 2. IT rooms: Provide 2 meters above cable tray.
 3. EOC: Provide 4-meter coiled loop under access floor for each outlet to allow for potential relocation of outlet in floor.

2.2 UTP PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1 when tested according to test procedures of this standard.
- B. All UTP cable shall be plenum rated cable.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- D. 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.
- E. Grounding: Comply with J-STD-607-B.

2.3 BACKBOARDS

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- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) mounted with long dimension vertical. Provide plywood sheets on all walls of each data room. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE HARDWARE

- A. Manufacturers:
 - a **Basis of Design: Panduit**
 - b Commscope Systimax.
 - c Tyco.
 - d Belden.
 - e Leviton
 - f BerkTek
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6A Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated. Blocks shall be 100 pair, or 300 pair as shown on drawings.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. Provide CAT 6A, 48 port patch panels for all horizontal cable connectivity.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables with lengths as shown below, terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
 - 3. Patch cord quantities: Provide a patch cord for each port in each patch panel.
 - 4. Patch cord lengths: 1 meter (for 1/2 of patch cords), 2 meter (for 1/2 of patch cords).
- H. Equipment cords:
 - 1. Provide one 3-meter equipment cord for each jack in each telecom outlet.
 - 2. Provide one 3-meter equipment cord for each of the 12 jacks in each 24 port patch panel consolidation point.

2.5 CONSOLIDATION POINTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Technology Systems Industries, Inc.
 - 2. Belden Inc.
 - 3. Chatsworth Products, Inc.
 - 4. Dynacom Inc.
 - 5. Hubbell Premise Wiring.
 - 6. Molex Premise Networks; a division of Molex, Inc.
 - 7. Ortronics, Inc.; a subsidiary of Legrand Group.
 - 8. Panduit Corp.
 - 9. Siemon Co. (The).
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - 2. Coordinate "Number of Connectors per Field" Subparagraph below with Drawings for quantity of connectors.
 - 3. Mounting: Furniture
 - 4. NRTL listed as complying with UL 50 and UL 1863.
 - 5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.11 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- B. Workstation Outlets: Two or Four port-connector assemblies shall be provided as noted on the drawings and shall be mounted in a single faceplate.
 - 1. Stainless steel plate:
 - 2. For use with snap-in jacks accommodating any combination of UTP
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - 3. Legend: Factory labeled by silk-screening or engraving for faceplates.
 - 4. Legend: Machine printed, in the field, using adhesive-tape label.
 - 5. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.12 GROUNDING

- A. Comply with requirements in Section 260526 and 270526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-B.

2.13 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.14 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables according to TIA/EIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider. Service providers to extend their D-marcs to the network closet.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters Conceal pathways and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
 - 3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

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- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-C.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - 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 UTP at least 49 feet (15 m) from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 10. 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.
 - 11. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-C.2.
 - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-C, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-B.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 3
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A or Class 3 level of administration, including optional identification requirements of this standard.
- D. Cable Schedule: Post in 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.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) 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 device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 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 being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - 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.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Visually inspect UTP cable 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/EIA-568-C.1.
 2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper 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.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-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.
6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.2.
7. Final Verification Tests: Perform verification tests for UTP and after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

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SECTION 276410 - RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS
(IN-BUILDING RADIO SYSTEM COVERAGE)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The contractor will design a fully functional signal booster system. Furnish, install and provide the cabling, conduit and pathways for a designed signal booster system. The system hardware will be provided by the owner if needed
- B. Coordinate with the owner the locations that the active equipment will be installed and design the cabling system to consolidate to those locations. Location shall be in a two hour fire rated room.

1.1 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Functional Block Diagram: Show single-line interconnections between components for the distribution system. Show cable types and sizes.
 - 2. Wiring Diagrams: For power, signal, and control wiring and transmission cable, include cross connects, taps, and other connections cords.
- D. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed system layout can be expected to perform up to specification. Calculate signal strength from sources to endpoints. Allowable losses between components and user interface shall be used to determine size and type of cable.
- E. Coordination Drawings: Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.

PART 2 – PRODUCTS

2.1 RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS

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- A. The contractor shall coordinate frequency requirements with the owner for fire, police, rescue and other services to be covered by the system.
- B. Completed cabling installations must comply with all applicable codes and standards, including Owner Building and Electrical Codes, NFPA, ANSI, NEC, OSHA, EIA, IEEE, R-56, etc., as well as the FCC Rules and Regulations, as applicable. Equipment provided must be UL listed and FCC type accepted for this specific application. Compliance to codes and standards must extend to include proper grounding, bonding and surge.
- C. The proposed system will provide digital signal strength coverage over 95% area on each floor/level of the equipped building. Systems must provide a minimum digital and analog coverage of Circuit Merit (CM) 3, with a reliability factor of 95%. A Coverage Acceptance Test must be executed prior to final acceptance of an installed system. Coverage acceptance testing must be based on audio quality performance in evenly spaced test grids in the defined service areas. A minimum of 20 tests will be taken per floor/level. Total number of test grids will be determined by the Owner, based on the size of the space per floor/level.
- D. Provide uninterruptable power source(s) (UPS) capable of maintaining the system operational for a minimum of 90 minutes.
- E. During initial installation, each system shall be optimized to perform in accordance with the specifications set forth in the system design, manufacturer's specifications and FCC regulations. The contractor shall ensure that uplink and downlink levels are properly set and consistent with design expectations. The contractor shall further ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications and FCC regulations. Prior to system acceptance, for each active BDA, booster amplifier, etc., the contractor shall submit a Proof of Performance certification, that lists the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
 - a. Worst case BDA uplink input level, in dBm.
 - b. Worst case BDA uplink output level, in dBm.
 - c. BDA downlink input level, in dBm.
 - d. BDA downlink output level, in dBm.
 - e. Noise and spurious products, BDA uplink output, in dBc.
 - f. Noise and spurious products, BDA downlink output, in dBc.
- F. The original Proof of Performance report must be submitted to project manager, and a copy of the Proof of Performance report must be affixed to its associated equipment.
- G. The system is designated for in-building use and must be designed and quoted as follows: Design and appearance will be of "finished" construction, i.e., must be concealed and/or unobtrusive. Surface raceway and/or exposed conduit installations will not be acceptable unless approved by the Owner in advance.
- H. At a minimum interface system to the fire alarm per below and per NFPA-72. Provide all additional fire alarm interface points per the manufacturers requirements.
 - a. AC Power Loss shall generate a supervisory condition on the Fire Alarm Control Panel.
 - b. Charger trouble shall generate a supervisory condition on the Fire Alarm Control Panel.
 - c. Low Battery shall generate a supervisory condition on the Fire Alarm Control Panel.
 - d. BDA trouble shall generate a supervisory condition on the Fire Alarm Control Panel

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- e. Antenna trouble shall generate a supervisory condition on the Fire Alarm Control Panel
- f. Abnormal Alarm condition shall generate a trouble condition on the Fire Alarm Control Panel

PART 3 – EXECUTION

3.1 INSTALLATION

- B. Furnish, and install the cabling, conduit and pathways for a designed signal booster system. The system hardware indicated in the contractor provide design will be provided by the owner. Conduit shall be as specified in 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Provide enclosures for all couplers/splitters and antenna connections.
- C. Visually inspect outside antenna installation. Correct any issues found with the antenna mounting hardware, grounding system, or outside cabling.
- D. Visually inspect inside BDA or booster amplifier equipment installation. Correct any issues found with RF cabling, electrical connection, or equipment mounting.
- E. Clean equipment fans, filters and other ventilation system components.
- F. Inspect and replace any defective indicator lights.
- G. Test UPS system performance for proper fallback to battery power and the duration of battery operation.
- H. Test fault reporting system for proper operation and reporting of system faults.
- I. Submit a written Preventive Maintenance Report to the Owner, listing the results of the optimization and preventive maintenance effort. The report shall include the Proof of Performance report for active RF components, and details of any other discrepancies found, and corrective actions taken.
- J. All as-built drawings shall be submitted to the Owner at completion, which shall include antenna system layout and all associated hardware, along with specification sheets. Include RF measurements taken.

3.2 WARRANTY

- A. The contractor must provide a full one-year warranty to cover installation and all components; the warranty must commence upon the Owner's final acceptance of the facility. Under warranty coverage, the successful contractor must provide same business day response time for system malfunctions.
- B. Test fault reporting system for proper operation and reporting of system faults.
- C. All as-builts will be submitted to the owner at completion, which shall include cable system layout, along with specification sheets.

END OF SECTION 27 64 10

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SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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. Electronic safety and security equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 QUALITY ASSURANCE

- A. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

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2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts: Of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

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- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes but is not limited to:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. Smoke detectors.
4. Duct smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device protective covers.
8. Fire alarm extender panels.
9. Magnetic door holders.
10. Remote annunciators.
11. Fire Fighter's Smoke Control Panel.
12. Addressable interface devices.
13. Digital alarm communicator transmitter.
14. System printer.
15. Extra materials.

- B. Fire alarm system shall control and monitor the status of all components of the smoke control system. Coordinate with Division 23.

- C. Fire alarm system shall monitor the status of the BDA-Signal Booster Systems. Provide a minimum of eight monitor points at the control panel. Mark un-used points as spare. Refer to specification 276410 for additional detail.

- D. The Fire Alarm System shall also include input devices and output relays to control the equipment associated with the smoke control system. Include minimum 20% spare relays beyond those indicated, including allowance for all work associated with utilizing spares for connection as directed in the field by Architect.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.

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- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 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.
 3. Provide UL file numbers documenting UL listing for purpose for every component of the system.
- B. Shop Drawings: For fire-alarm system.
1. Include plans, elevations, sections, details, and attachments to other work.
 2. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 3. Include voltage drop calculations for notification appliance circuits (NAC). Load visual NAC's to a maximum of 60% capacity to allow for additional devices or resetting candela output of devices provided.
 4. Include battery-size calculations.. Load batteries to a maximum of 60% capacity to allow for additional devices or resetting candela output of devices provided.
 5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 6. Include 1/8" = 1'-0" scale floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
 7. 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.
 8. Detail assembly and support requirements.
 9. Include input/output matrix.
 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. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
- C. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable..
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

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1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Provide "As-Built" prints and PDF format copies of layout floor plans indicating all field revisions since shop drawing submittals. Updated prints shall have been made in CAD, not hand markups. Provide disk with AutoCAD compatible plans of As-Built plans.
 4. Record copy of site-specific software.
 5. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 6. Manufacturer's required maintenance related to system warranty requirements.
 7. Abbreviated operating instructions for mounting at fire-alarm control unit.
 8. Copy of NFPA 25.
 9. Device address list including plain text descriptions/locations, room names and numbers coordinated with Owner's actual designations, not necessarily those on the Contract Documents.
 10. Warranty: Signed copy of warranty and software agreement..
- 1.5 A documentation cabinet shall be installed at the system control unit or at another approved location at the protected premises for storage of all record documentation. Where the documentation cabinet is not in the same location as the system control unit, its location shall be identified at the system control unit. The documentation cabinet shall be prominently labeled SYSTEM RECORD DOCUMENTS. (2013 NFPA 72 National Fire Alarm and Signaling Code Section 7.7.2).
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications:
 1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation shall be supervised by personnel certified by NICET as fire-alarm Level III technician.
 - B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 1. Fire Alarm Systems and components performing release service shall be listed and labeled for that purpose.
 2. Fire Alarm System and components that are part of the Smoke Control System shall be listed and labeled per UL864 classification UUKL.

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1.7 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Final Acceptance, provide software support for one year.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within year from date of Final Acceptance. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.8 EXTRA MATERIALS

- A. Provide extra materials described below that match products installed including installation. Uninstalled devices shall be packaged with protective covering for storage, identified with labels describing contents and turned over to the owner at the completion of the project.
 - 1. Fuses (If Used)2 of each size in system
 - 2. Manual Fire Alarm Boxes.....2% of installed quantity
 - 3. Addressable Control Relays.....4% of installed quantity
 - 4. Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
 - 5. Indoor Strobe-only Notification Appliances.....4% of installed quantity
 - 6. Monitor Modules (Addressable Interface)4% of installed quantity
 - 7. Isolation Modules / Isolation Bases.....4% of installed quantity
 - 8. Addressable, Electronic Heat Detectors.....4% of installed quantity
 - 9. Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity
 - 10. No spares are required for projected beam, air sampling, or duct smoke detectors
- B. Contractor shall itemize Extra Materials material and labor on the project Schedule of Values.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **Five** years from date of Final Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work are not limited to the following:
 - 1. Gamewell; a Honeywell company.
 - 2. GE Infrastructure; a unit of General Electric Company.

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3. Notifier; a Honeywell company.
4. Siemens Building Technologies, Inc.; Fire Safety Division.
5. Simplex; a unit of Tyco Fire Protection

B. SUBSTITUTION REQUESTS

1. Substitution packages shall be submitted to Architect no later than fifteen days (15) prior to bid for review and approval.
2. Provide data requested SUBMITTALS -Product Data above

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Preaction system. (if present)
7. Kitchen Hood Fire Suppression System.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Deactivate designated heating, ventilating, and air-conditioning equipment.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate smoke control system(s).
9. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system (if present).
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall 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 primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.

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7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Initiation Device Circuits (IDC) to be wired Class A (NFPA 72 Style D) and Alarm Notification Appliance (NAC) circuits to be Class A (NFPA 72 Style Y). Signal Line Circuits (SLC), also called addressable loop - alarm, trouble and supervisory signals from all intelligent reporting devices, shall be encoded onto a Class 6 (NFPA 72 Style 6) with no "T" taps.

D. Smoke-Alarm Verification:

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1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium or Vented, wet-cell pocket, plate nickel cadmium. Minimum battery capacity compliant of 60 hours battery power capacity, plus 5/15 minutes of full alarm load. Proprietary and other systems require 24 hours capacity plus 5/15 minutes alarm load.
- J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- 2.4 FIRE ALARM EXTENDER PANELS (FNAC)
- A. FNAC's contain power supplies, batteries and notification appliance circuit cards to drive notification appliances, for systems too large to be driven directly from the FACP. Also referred to as Booster Power Supply.
 - B. FNAC Listed and labeled per UL classification UOXX or UOJZ as a component of the fire alarm system.

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- C. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.
- D. Signaling line circuit between FACP and FNAC shall be supervised.

2.5 MANUAL PULL STATIONS

- A. Description: Fabricated of plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.
 - 1. Double-action mechanism requires two actions, such as a push and a pull, to initiate an alarm.
 - 2. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
 - 3. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 - 4. Pullstations shall be key operated in inmate accessible areas.

2.6 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:

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1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall 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.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall 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.).
3. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
4. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable (controlled by the FACP, not by the detector itself). Relay shall be mounted within 3 feet of HVAC control circuit.
5. Duct Housing shall provide a relay control trouble indicator Yellow LED.
6. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
7. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
8. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
9. Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch. If the station is not located directly below the detector, provide permanent signage at the station indicating detector location.
10. Where located outdoors, provide NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

2.7 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.

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- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C)] per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, white.

2.9 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 3. Rating: 24V powered from the fire alarm system.
 - 4. Provide a monitor and/or releasing module as required
- B. Material and Finish: Match door hardware.

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2.10 ADDRESSABLE INTERFACE DEVICES

- A. Monitor Module: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.
- B. Control Module: Microelectronic control module listed for use in providing a multiplex system address with normally open and normally closed contacts. Used to interface operation with non-system devices and equipment such as dampers, starters, and relays.

2.11 REMOTE TEXT ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, 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 shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit shall automatically dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either transmission method (see below) is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of transmission to the remote alarm receiving station over the remaining line. Transmitter shall automatically report transmission restoration to the central station. If service is lost on both transmission methods, transmitter shall initiate the local trouble signal.
- C. The communication methods used to transmit signals to the remote supervising station shall meet the requirements of NFPA 72 National Fire Alarm and Signaling Code
 - 1. Provide a DACT (Digital Alarm Communicator Transmitter) using a standard telephone (POTS) as the primary means of communication.
 - 2. Provide an IP DACT (Internet Provider Digital Alarm Communicator Transmitter) using an owner provide IP telephone (VoIP) as the alternative transmission and/or redundant, secondary path
- D. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.

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2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

E. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 FIREFIGHTER'S SMOKE CONTROL PANEL

A. Coordinate with Division 23.

Smoke Control Panel shall be control units listed for all appropriate functions in the UL Fire Protection Equipment Directory under classification UUKL. Wall-mounted panel with a graphic display of the building plans, with switches and LED indicators. Refer to details on Drawings. The control panel shall be mounted in a surface mounted enclosure, with concealed conduits. The control panel shall be constructed with a 0.125-inch aluminum substrate and a 7 mil polyester film overlay. The polyester film overlay shall be protected by a non-glare textured coating that is non-yellowing, durable, and scratch resistant. LEDs, resistors, diodes, etc., shall be mounted on printed circuit boards (PCBs). All wiring to the PCBs shall be made on solder type terminal turrets. All switches shall be mounted from the rear of the panel.

1. Graphic Colors: The film overlay shall be a graphic as shown in the drawings with black lines and legends, and colored background areas and text. The graphic is to be made of 7-mil photographic film, having all accent colors applied to the backside of the film. Important areas such as stairwells and smoke control panel locations shall be highlighted for easy identification. The panel supplier shall furnish a color chart with a minimum of 22 accent colors.
2. Graphic Surface: The working surface (polyester film) shall be bonded to the aluminum substrate with an adhesive that has been proven not to delaminate in similar applications. The adhesive shall achieve 100% bonding without any creases, bumps, or blemishes in the working surface (face) of the graphic. The working surface of the graphic shall be textured and non-glare. Translucent areas shall be made in the overlay for back lighted indicators. LEDs shall not protrude through the polyester film overlay. Backlit areas shall be subdued until the LED is illuminated. The illumination of any indicator shall be clearly visible, from any viewing angle in front of the working surface of the graphic.
3. Substrate: The aluminum substrate shall have holes for LEDs and switches. The substrate shall have holes drilled and tapped for mounting the printed circuit boards. The aluminum substrate shall have a clear irridited finish to prevent oxidation.

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4. Indicators: The indicators shall be high intensity LEDs, T-1 ¾ in size, and rated for a normal operation at a current of 20mA. The LEDs shall have an operating life of a minimum of 170,000 hours of continuous or pulsed operation. The body and lens of the LEDs shall be constructed of high impact plastic. The LEDs shall be mounted on .062" printed circuit boards constructed of epoxy glass material, NEMA Type FR-4, Grade 10 resistors and diodes for current limiting and LED test shall also be mounted on the printed circuit boards. Solder type, pressed in turrets shall be provided for electrical connections to the LEDs. All field wiring shall terminate on modular screw clamp type terminals located in the rear of the enclosure.
5. Switches: Three position switches shall be furnished for ON-OFF-AUTO operation of each system zone or sub-zone where indicated on the drawing. Switches shall be rated for the load served. A momentary push button shall be provided for simultaneous testing of all LEDs. All switch wiring shall be terminated on modular screw clamp type terminal strips mounted in the rear of the enclosure.
6. Enclosure: The enclosure shall be made from cold rolled steel and be assembled using all welded and formed steel construction. The enclosure shall be primed and painted with a baked enamel and have a textured finish. A security door with a viewing window shall be supplied to prevent unauthorized operation of the control panel switches.

2.14 GUARDS FOR PHYSICAL PROTECTION

A. Inmate accessible areas

1. Smoke detector guard shall be a model permitted by the smoke detector manufacturer's installation instructions and listing. Construction shall be 16-gauge steel with powder coat enamel finish.
2. Visual and Audio/Visual Notification Appliances guard shall be a model permitted by the appliance manufacturer's installation instructions and listing. Construction shall be 16-gauge steel with powder coat enamel finish.

2.15 TRANSIENT PROTECTION

- A. Provide transient protectors for conductors (including conductive fiber cable, if present) entering each building from the outside, in accordance with NFPA-70, Article 800, and as recommended by the manufacturer for the type of line being protected.

2.16 FIRE ALARM WIRE AND CABLE

- 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. Comtran Corp.
 2. Draka USA.
 3. Genesis Cable Products; Honeywell International, Inc.
 4. Rockbestos-Suprenant Cable Corporation.
 5. West Penn Wire/CDT; a division of Cable Design Technologies.

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- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
- E. All fire alarm circuitry shall be run in conduit in accordance with Section 260533 "Raceways and Boxes."

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
 - 1. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A [or Appendix B]in NFPA 72.
 - 4. HVAC: Locate detectors not closer than [3 feet (1 m)] [5 feet (1.5 m)] from air-supply diffuser or return-air opening.
- D. Duct Smoke Detectors: Comply with manufacturer's written instructions.
 - 1. Furnish duct smoke detectors and instructions for installation to the contractor performing work under Division 23.
 - 2. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 3. After installation by Div 23, verify devices are installed in accordance with the manufacturer's instructions.
 - 4. Provide circuitry and connections.
- E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

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- F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install at least 6 inches (150 mm) below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- J. Graphic Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- K. Text Annunciator: Install with top of panel not more than 46 inches (1830 mm) above the finished floor.
- L. Smoke Control System Sequence: In accordance with IBC 909-17, the smoke control system shall activate components in an appropriate sequence. Fans, dampers, damper position dry contacts, differential air pressure switches and other components of the Smoke Control Systems are furnished and installed by Division 23. Refer to Division 23 Contract Documents and coordinate work with Div 23. Each step in the sequence has a time duration, which shall be listed in the Contactor's sequence submittal with incremental and total time required for operation. In principle, minimum sequence steps include but are not limited to:
 - 1. Smoke Detector detects smoke. FA system resets detector and waits for automatic alarm verification before initiating alarm and smoke control sequence. Up to 15 seconds duration.
 - 2. System sends signal to FA control module(s) to open/close appropriate dampers and, where applicable, shut down HVAC systems. Up to 20 seconds duration.
 - 3. System receives confirmation from damper monitor modules that dampers are in correct position. Up to 10 seconds duration.
 - 4. System sends signal to FA control module(s) to activate smoke control fans. Up to 5 seconds duration.
 - 5. System receives confirmation from monitor module at smoke fan motor differential pressure switch relays that associated fan(s) are operational. Up to 10 seconds duration.
 - 6. Total sequence duration: $15 + 20 + 10 + 5 + 10 = 60$ seconds delay from detection of smoke until full system operation.
 - a. If a flow switch causes smoke control system activation, the 15-second smoke verification delay for smoke detector activation (item 1 above) shall not occur (allow 5 seconds for flow switch) bringing the total to 50 seconds.
- M. Smoke Control System Testing
 - 1. The fire alarm system shall be programmed to initiate a weekly test of the smoke control system per IMC513.12.1. The test shall include positive confirmation of actuation, testing, and the presence of power downstream of all disconnects. A preprogrammed weekly test sequence shall report abnormal conditions audibly, visually and by printed report. The preprogrammed weekly test shall operate all devices, equipment and components used for smoke control except initiation devices.
 - 2. Consult the owner for day and time for this test to occur.

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3.2 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 Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to activate emergency lighting control.
 - 3. Supervisory connections at valve supervisory switches.
 - 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated.
- B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the 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 the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Taps are specifically prohibit other than at device terminal blocks, or on terminal blocks in cabinets Use numbered terminal strips in cabinets or equipment enclosures where circuit connections are made.
- D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code 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.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

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3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

- A. Coordination of work progress is the responsibility of the contractor. Smoke Control System components are to remain open for inspection such that the entirety of the system installations can be inspected upon the request to witness the duct leakage tests. The number of visits for inspection and duct leakage testing is to be minimized. Contractor shall notify the Owner and Special Inspector of project readiness and schedule inspections accordingly. The cost of re-inspections for failed smoke control system installation, lack of system readiness or duct leakage test failure shall be at the expense of the contractor.
- B. Smoke Control System programming and functionality are to be fully completed and successfully pre-tested prior to notification of the Special Inspector to witness testing. The building will be wholly complete prior to Smoke Control System testing such that there are no installations or corrective actions still open that may impact system operation. The system will be pre-tested in this condition and passing results presented to the Special Inspector upon invitation to witness testing. The cost of retesting the smoke control system due to system failures, lack of system readiness, or any failure to meet the prescriptive operational requirements shall be at the expense of the contractor.
- C. Field tests shall be witnessed by authorities having jurisdiction.
- D. 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.
- E. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Smoke control inspection and testing shall be performed per the NC Building Code (2012 Ed.) Section 909.18.8.
 - a.

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4. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
7. Test smoke control system for operation per the Contractor-submitted control sequence, and per the requirements of IBC 909.18, including but not limited to "Special Inspections."
8. Testing shall include but not be limited to the following
 - a. Initiate one or more smoke detectors in the space using an approved method such as a smoke canaster.
 - b. Monitor the dampers, and units associate with the smoke zone and provide a written log that each device operated per the Fire Matrix on the drawings and that each device returned to its normal state after the test.
 - c. Test each control switch and RTU switch on the smoke control panel in each position. and provide a written log that each device operated correctly, and that each device returned to its normal state after the test. Place all switches back in automatic position after the test.

- F. Fire-alarm system will be considered defective if it does not pass tests and inspections. Take corrective action and retest until accepted by the AHJ.
- G. Prepare test and inspection reports.
- H. Annual Test and Inspection: One year after date of Final Acceptance, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Schedule training in 2 sessions at the Owner's convenience.

END OF SECTION 283111

SECTION 285000 - SECURITY CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. The general contractor shall contract the services of a qualified Security Controls System Contractor (SCSC) and shall be responsible for the Security Controls System Contractor (SCSC) and the systems they shall provide as part of the Division 28 specification sections.
- B. All Work associated with a complete and fully functional Security Control System shall be provided by the Security Controls System Contractor (SCSC). This Work and system shall include, but may not be limited to, all conduit, raceway, wire, terminations, backboxes, devices, equipment, products, services, and overall systems integration. The installation or furnishing of such Work by other trades, including the Electrical Subcontractor, shall not be acceptable unless they are a direct subcontractor to the SCSC.
- C. The SCSC shall provide all equipment, shop drawing submittals, testing reports, and samples as described in Specification Sections 285000, 285010, 285020, 285030, 285100, 285200, 285220, 285260, 285300, 285400, 285500, and 285900.
- D. The SCSC shall provide a software data flow diagram/chart indicating in what programs and where all control logic will reside. Provide a detailed description of software solution and all secondary software or drivers used to interface or integrate all the security systems. All computers listed throughout the security control system in specification sections 285000 – 285900 shall use Windows 10 or better operating system. All servers listed throughout the Security Control System specification sections 285000 – 285900 shall use Windows Server 2016 or better.
- E. All software shall be readily available through conventional sources and all programming shall be written utilizing language simplistic enough to be modified in the future by Owner's qualified staff or a third party integrator. If it is found the SCSC provided non-modifiable programming language or encrypted software but did not disclose this information, the system shall be completely redeveloped with modifiable programming methods at the SCSC's expense.
- F. The SCSC shall turn over to the Owner all programming passwords, source codes and programming schedules at Substantial Completion. Prior to final payment, the SCSC shall provide all software, licenses, information, training, and any other items needed to allow the Owner to make future modifications to programming utilizing options other than the original SCSC.
- G. Summary
 - 1. The SCSC shall be responsible for coordinating with Division 8, Division 11, and Division 26, the power and cabling requirements of all electric strikes, electric locks, door position indicators, or any other device associated with and controlled/monitored by the Security Control System. This coordination includes the identification and resolution of potential conflicts in the scope of work between these Divisions.
 - 2. Types of Security Control System components/features/interfaces:
 - a. The SCSC shall be responsible for all Division 28 field device installation, terminations, and equipment configuration.

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- b. Provide a complete fully functional Security Control System.
- c. Provide all conduit, raceway, wire, terminations, backboxes, and equipment for a complete system. All security cabling shall be in conduit the entire distance of the run unless otherwise noted.
- d. Provide proper control of detention hardware as supplied by Division 11 and security hardware as supplied by Division 8. Coordinate all architectural doors with security devices to ensure proper lock, lock power, and control wiring to these locations.
- e. Provide all necessary distributed AC/DC system power, unless otherwise noted.
- f. The complete Security Control System shall be connected through UPS power and generator power.
 - 1) Provide interface with UPS to VGUI system for annunciation of UPS trouble alarms on the VGUI.
 - 2) Provide interface with emergency generator to VGUI system for annunciation of generator trouble alarms on the VGUI.
- g. Prior to fabrication, coordinate exact location and installation of Security Control System with other trades.
- h. Provide complete system test and written operational certification to the Architect/Engineer and Owner prior to substantial completion.
- i. Provide Owner training by factory-trained and authorized personnel as specified.
- j. Turn over to Owner all termination point and interconnection schedules, all programming source codes including VGUI software, PLC development software, VMS software, VMS viewing software, video system software and applicable license required for operations. This is to also include the VGUI and security management system and runtime licenses.
- k. Flat VGUI panel Control Consoles to integrate the controlling and monitoring of all doors, alarms, video, intercoms, card access and other designated device annunciations. VGUI Control shall have the ability to monitor all security devices and components throughout the entire facility during normal operations.
- l. Audio Communications system.
- m. Provide IP based color video System with network video recording.
- n. Provide Video Client workstations as indicated on the drawings.
- o. Provide cameras, lenses, housings and accessories for interior and exterior applications.
- p. Provide complete Access Control System and interface with indicated architectural doors, barrier arm gates and pedestrian gates for remote control and/or monitoring. Coordinate with the Owner to ensure the Access Control System provided under this contract can use all types of cards and credentials currently being used by the Owner.
- q. Provide all furniture-mounted and wall-mounted duress alarms
- r. Provide Security System Interface, cabling & connection for remote warranty troubleshooting and maintenance. Coordinate VPN connection with County/Sheriff's IT department during submittals. Connection shall be able to be physically disconnected when use is not required.
- s. Interface to plumbing system for water shutoff in holding areas and housing unit cells via VGUI control.
- t. Interface to lighting control for holding areas, cells and housing units via VGUI control.
- u. Provide Talk-thru Units (TTU) and Talk-thru Communicators (TTC).

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- v. Coordinate all lighting pole mounted camera locations with Division 26. Coordinate conduit, wiring, and termination responsibility.
 - w. Provide all spare components as specified.
 - x. Other controls, annunciation & monitoring indicated in the Division 285xxx specification sections and on the Drawings.
- H. Electrical Contractor: (SCSC shall coordinate with EC & GC)
- 1. Coordinate all electrical requirements with both the SCSC and General Contractor.
 - 2. The Division 26 contractor shall be responsible for the coordination of conduits/cable raceways of architectural door frames with security hardware provided by Division 8. The SCSC shall be responsible for coordinating with Division 8, Division 11, and Division 26, for the power and cabling requirements of all electric strikes, locks, door position switches, or any other device associated and controlled/monitored by the Security Control System.
 - 3. Provide termination of all 120-volt power connections required by the Security Control System for the computer and monitoring equipment at various security control stations.
 - 4. Lighting and Receptacle control relays and terminations shall be done by the electrical contractor. SCSC to coordinate interface to relays and termination of outputs.
 - 5. Provide all 120V power connections from emergency/generator power panels.
 - 6. Coordinate with the SCSC and provide 120V power for:
 - a. At the vehicle drive up card reader / intercom / camera post
 - b. At all power supplies in hardware sets for architectural doors, as listed in Specification Section 087100 – Door Hardware.
- I. General Contractor: (SCSC shall coordinate and make the GC aware of these requirements)
- 1. Coordinate the inter-related work of the SCSC, Div. 11, Div. 8, millwork provider, and Div. 26 Contractors.
 - 2. Include detailed scheduling information for Security Control System installation and testing in the construction schedule. Provide the SCSC two months of testing and troubleshooting of the installation of his equipment near the end of the project. When the system is completely installed, provide the SCSC free access and total control with no other construction traffic for a period of two weeks for proper testing and certification of the system.
 - 3. Provide coordination to ensure that control rooms and Security Electronics rooms are completed as early as possible to facilitate installation of control wiring. Control room(s) and Security Electronics equipment room(s) shall be free of airborne contaminants from cutting, grinding, painting, masonry work, etc., prior to the installation of any Security Electronics equipment. HVAC system must be started and running at a temperature and humidity level required for the operation of the equipment in the spaces.
 - 4. Conduct periodic coordination meetings between security, electrical, plumbing, masonry and all other contractors to make everyone aware of critical areas of construction. Distribute the meeting minutes and attendance to the Architect/Engineer and Owner.
 - 5. Provide coordination with the SCSC to complete the inspections, submittal and closeout documentation as described in the general provisions.
- J. Detention Equipment Contractor (DEC):
- 1. Coordinate with the General Contractor, Electrical Contractor and SCSC.
 - 2. Furnish, install, and terminate detention hardware.

3. Provide all the necessary and proper adjustments for correct hardware operation.

1.3 QUALITY ASSURANCE

- A. Work shall be in accordance with the applicable federal, state, and local codes or standards current at the commencement of installation. Where more than one code or regulation is applicable, the more stringent shall apply. All Security Contractor Licensing requirements for contractors and subcontractors shall be enforced as per applicable codes and statutes (refer to the North Carolina Department of Public Safety; www.ncdps.gov).
- B. Cable installation, identification and termination shall be performed in accordance with the Manufacturer's technical installation guidance, in addition to the applicable codes and statutes.
- C. All conduit within the secure perimeter shall be concealed when possible. If exposed, all conduit shall be mounted as close to ceiling as possible. Conduit, backboxes, and devices shall be mounted tight to the surface utilizing tamper resistant security screws.
- D. All screws and fasteners for the new equipment within the security perimeter shall be tamper resistant security screws, requiring a special tool.
- E. In the absence of the Manufacturer's recommendations on conductor applications, the Security Control Systems Contractor (SCSC) shall ensure that the cabling selected meets all technical requirements of the equipment to be installed.
- F. An SCSC is required for this project. It is critical that the SCSC understands and meets the requirements of the Contract Documents, the equipment specified and security control systems integration. And, that the equipment is properly installed and functionally ready for use at time of completion specified for the facilities.
- G. Division and separation of total responsibility for contract delivery of the security control systems will not be acceptable.
- H. The SCSC shall be able to respond on site with qualified personnel to emergency service within 12 hours of notification.
- I. The SCSC shall be responsible for providing a complete security control system. This shall include but not be limited to, cabling, cabling raceways, terminations of all system cabling, all distributed AC and/or DC power, field devices and control components, systems start-up, acceptance testing, training, and the complete and total integration of all systems utilizing 'In-House' software programming expertise.
- J. Available Security Control System Contractors (SCSC):
 1. Accurate Controls Inc. – Ripon, WI
 2. Cornerstone – Madison, AL
 3. Esitech Inc. – Richmond, VA
 4. Johnson Controls – Montgomery, AL
 5. Montgomery Technology Inc. (MTI) – Greenville, AL
 6. Securitas, Noblesville, IN
 7. South Western Communications – Decatur, AL
- K. It is not, however, the intent of the Owner or Architect to unfairly restrict competition. Other equally competent SCSCs who meet the 'qualification criteria' specified herein shall be added to the list of 'Available Security Control System Contractors (SCSC)' by addendum. Verbal

approval will not satisfy this requirement. Grounds for disqualification shall exist if, in the opinion of the Architect, the information submitted is inaccurate or does not comply with the requirements of this specification. There will be no exceptions. All competent non-listed SCSCs may request to be listed by submitting the data requested in the paragraph 'Qualification Criteria for the SCSC', a minimum of fifteen (15) days prior to bid receipt date. If the bid date is extended for any reason, the qualification period will not be extended.

L. Qualification Criteria for the SCSC

1. Contractor Qualification Statement AIA-A305 shall be filled out in its entirety. Some of the additional criteria in this section may have similar requirements as those found in the A305 form, but such similarities shall not create an exemption to answer the questions on the A305 form.
2. The SCSC shall have been actively engaged in the design and delivery of electronics security control system solutions. Provide a historical narrative of the company from inception; including history of ownership, partnership, incorporation and/or other organizational information. Include information on the growth of the firm over time to include number of employees, relocation(s) of the firm, mergers and acquisitions. Use only the current corporate/business entity, intending on bidding and performing the work.
3. Provide documentation of experience. List two (2) projects completed in the last 10 years for the state in which this project is located. Out of state experience will not be considered. List only projects with cost of security electronics portion in excess of \$165,000 and of similar scope. Documentation is to include project names, addresses, description of systems, and the names, addresses, telephone numbers, and contact persons of the contractor and/or owner for whom the work was done.
4. Provide statement that firm has been in business for minimum of five continuous years under the current name.
5. Provide a resume of all key employees in supervisory positions; include their current position, time of service in current position, years as a full-time employee of the SCSC, and number of years of experience in the corrections and criminal justice markets.
6. Submit a block diagram of two previous projects which are similar in scope outlining all major and minor system components within the security control system as well as related systems, describing the integration of both hardware and software required for the complete system.
7. List of projects currently under construction including project size, scope and location.
8. Submit a listing of all jobs which the SCSC is presently or has been involved in litigation and the status thereof.
9. Provide a list of all jobs where your firm has been involved in liquidated damages or where delay damages were filed against your firm.
10. Submit a current letter from the proposed security control system equipment manufacturer's stating that the SCSC is factory trained, fully authorized distributor and installer of their complete line of products.
11. Provide signed statement that SCSC has not been found guilty of charges relating to conflicts of interest or to any criminal activity relating to construction methods, bidding, bid rigging, or bribery in the past five years.
12. Provide signed statement that SCSC has not been found guilty of charges relating to employment of illegal aliens on construction projects in the past five years.

13. Provide a letter from 'A' rated surety company that your company will be able to provide a Performance/Payment bond for this project if awarded the project.
14. The SCSC shall have sufficient financial ability to perform the contract that would result from such procurement. If a bond is required to ensure performance of a contract, evidence that the Contractor can acquire a surety bond from a corporation included on the United States Treasury list of acceptable surety corporations in the amount and type required by the public body shall be sufficient to establish the financial ability of such SCSC to perform the contract resulting from such procurement.
15. Name, address and telephone number of organization's current Bonding Company and level of bonding capacity.
16. The SCSC shall indicate complete and total compliance with the provisions of this specification by letter signed by an officer of the corporation or a principal if other ownership currently exists.
17. Provide the security control system contractor's license number.

1.4 SECURITY CONTROL SYSTEM TRAINING

- A. Provide supervisory, operational, and maintenance training outlines and training materials thirty (30) days prior to training.
- B. Provide complete supervisory and operator training for the Owner's personnel at the end of construction.
 1. Provide three (3) eight-hour sessions on consecutive days at times set by the Owner. This may include 2nd and 3rd shift times to accommodate all officers. These should be scheduled as part of the Owner's pre-occupancy transition training.
 2. Provide one (1) eight-hour session at a time set by the Owner for maintenance training of the system.
- C. Provide an interactive training DVD's for all system operations and system troubleshooting. Provide system operations and system troubleshooting training on separate DVD's. Provide two copies of each.
 1. This DVD shall be carefully organized and segmented so that training may be given on the complete system or on specific functions as may be appropriate.
 2. The DVD shall contain computer-generated screen animation with narration describing icon selection, graphic animation and operation.
 3. The maintenance portion of this DVD shall contain still images with graphics and narration describing all equipment states and troubleshooting methods including LED indication and text read out.

1.5 SUBMITTALS

- A. The SCSC shall submit four (4) submittals for this project. Each submittal shall contain all the necessary criteria for all Div. 285xxx sections, and for each subsequent re-submittal if necessary. Submittals 1 (Product Data) and 2 (Shop Drawings) shall be submitted at the same time. Following this process will afford the submitted information to be reviewed more efficiently. All the necessary information the reviewer needs to properly evaluate the submission will be in the package each and every time it has to be reviewed. Failure to follow these submission requirements shall constitute the submittal(s) as being non-compliant and will be returned as "Rejected/Resubmit".

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- B. It shall be the responsibility of the Architect and OWNER to completely review and approve all details of the VGUI control console screens prior to release for final software production. Any applicable changes made prior to release for software production shall be made at no cost to the Owner. (Refer to Part 3 - Execution, paragraph 'Software Supports'.)
- C. The submittal packages shall consist of one (1) reproducible (digital format) copy for each of the four (4) submittal types listed below. Each of the submittal types listed below shall include information from all the Div. 285XXX sections, as stated in paragraph A above. Provide electronic bookmarks, hyperlinks and divider pages to help navigate to and within the documents. Bookmarks and divisions shall match what is provided in the submittal's table of contents.
1. Product Data:
 - a. Provide Title Page and Table of Contents. Organize document by spec sections as listed in the Project Manual. Provide electronic bookmarks and divider pages to allow reviewer to navigate to spec sections and the different items within each section.
 - b. A Bill of Materials for each system, which shall include manufacturer names, model numbers, and quantities of all equipment proposed. It is acceptable to combine the Bill of Materials with the Table of Contents or section headings, provided all the required information is provided.
 - c. Technical product information clearly marked to identify the principal component(s) proposed. Information shall be listed in same order as presented in Table of Contents.
 - d. Specifications information for each type of cable required (power and data) and its application.
 - e. Markings: Submit for approval the SCSC's proposed wire marking, panel label, zone label, terminal strip numbering & terminal strip identification styles and typical text as outlined.
 - f. Shall be submitted at same time as Shop Drawings Submittal.
 2. Shop Drawings:
 - a. All drawings shall be computer-generated for expedient modifications if required. At completion of the project, these drawings, along with any field changes, shall become part of the Contract Documents. Refer to paragraph titled "Record Drawings" ahead.
 - b. Building Floor Plan / Device Layout drawings: These drawings shall indicate the accurate locations of all equipment associated with each system in respect to architectural and structural conditions. Size drawings of components, equipment layouts and other small size areas to the common scale of 1/8", 1/2" or 1" per foot. Size drawings of larger areas to the common scale of 1/4" or 1/8" per foot. Drawings shall include explicit notes on the termination of all conductors and shields for each location. Architectural backgrounds shall be in accordance with the latest architectural drawings and shall be complete with elevations, sections, and details as required to depict the installation. These drawings shall be approved prior to starting work.
 - c. Equipment Room Layout Floor Plans:
 - 1) Scaled plan drawings indicating the placement of all required security control system components/racks and their relationship with all other adjacent objects.

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- 2) Indicate clearance and maintenance access requirements and confirm all necessary clearances around components for both installation and maintenance have been coordinated.
- 3) Dimension the location of and provide installation details of the security control system's 'Head-End' racks, including mounting and anchorage provisions.
- 4) Provide elevations of each rack indicating the location of all equipment and components.
- d. Control Room Enlarged Floor Plans and Elevations: Provide detail drawings depicting the plan location and elevation of all equipment to be provided within each security control room.
- e. Block Diagrams:
 - 1) Provide block diagrams of all systems/sub-systems showing interconnects and relationships as a complete system.
 - 2) Describe all power requirements and connections. Indicate line and low voltage information, all UPS, battery back-up, and emergency/generator power.
- f. Provide complete "point to point" wiring diagrams for all systems and subsystems. Indicate all components in the communications path from Central Control through all intervening system components, including terminal boards to the individual end devices. Document dedicated leased lines and associated equipment required to complete a transmission path. Where conductors are grouped into a cable for long site runs, a single line properly identified shall be indicated. Where these cables fan out for termination, individual wire terminations and markings shall be indicated.
- g. Wire management details for the installation of cable harnesses inside racks, equipment cabinets, and consoles, control panels and other areas of exposed cable.
- h. Shall be submitted at the same time as the Product Data Submittal.
3. Test Procedure:
 - a. Provide written document detailing the test procedure for substantial completion of the system provided. These procedures shall include all tests recommended by the equipment manufacturer and by this specification.
 - b. Provide samples of system approval test sheets for review.
4. Screen Shots:
 - a. VGUI Control Console "Screens": Submit for approval a detail drawing or screen snap shot of each control console "screen" depicting the exact layout to full size scale. Screens that distort the building floor plan layout are not acceptable. Representation of all colors shall be included, as well as the operator's orientation of the control panel in relationship to the control room and building.
 - b. Include a glossary of all icons available and a description of their function and actions shown beside an image of each of their varying states of status.
 - c. The review and approval of this submittal will only serve as a basis for proceeding forward with Phase I meeting of Software Support as described in paragraph 3.3.A. A second Screen Shot submittal shall be provided after the Phase I meeting to reflect any decisions made during that process.

1.6 TESTING

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- A. The Security Control System shall be assembled and tested at the SCSC's shop. Refer to paragraph 3.3.B for Phase II expectations and requirements.
- B. Submit approved substantial completion test sheets seven (7) days prior to scheduled testing date.
- C. Conduct with Owner and/or Architect a comprehensive system test of all system components per the approved test plan. At completion of all testing, provide substantial completion test sheets.

1.7 RECORD DRAWINGS

- A. The SCSC shall obtain, pay for, and keep up-to-date and available to the Owner or its representative, complete black-line prints as well as magnetic media copies of all computer drawings of the project, clearly annotated with "as-built" data as the work is performed. This data shall include the following:
 - 1. Routing of conduit and raceway.
 - 2. Routing of signal and power wire and cables, including the designations assigned to each wire/cable and field terminations schedules.
 - 3. Accurate location of all equipment installed under the specifications.
 - 4. A complete equipment list for each functional area.
- B. Upon completion and for inclusion into the Final Record Sets of drawings of this project, all as-built information shall be transferred to a full size set of AutoCAD drawings and transmitted to the A/E within 30 days of substantial completion.

1.8 GUARANTEE

- A. The SCSC shall guarantee all equipment & systems for a period of two (2) years commencing with Substantial Completion. The guarantee shall cover all costs for Warranty Services, including parts, labor, prompt field service, pick-up and transportation.
- B. The SCSC shall also provide an extended warranty for computer hardware that includes critical maintenance support services for a period of five (5) years commencing with Substantial Completion. Critical support services shall be available 24 hours per day, 365 days per year, with 4 hour onsite response time.
- C. The Owner shall be listed and registered as the owner of all SCSC provided equipment and software no later than the completion of the contractual warranty period.

1.9 WARRANTY AND PREVENTATIVE MAINTENANCE SERVICES

- A. The SCSC shall design the Security Control System to provide for remote PC connection with the new security control system. This remote connection shall be used by the SCSC during the warranty period for remote system troubleshooting and maintenance. The Owner/user will activate and de-activate the local communications device to ensure that unauthorized remote access to the security control system will not occur.
- B. Maintenance services within this scope of work shall include a preventative maintenance and system optimization inspection to be conducted every three (3) months during the first year of warranty. These visits shall be recorded at the site by signing in the Owner's daily operations log book and shall include, as a minimum, the following:
 - 1. Configuration Checks on video recorders

2. Verify the integrity of all system software including Remote Viewing Stations.
 3. Configuration Checks on Access Control System Components and Software.
 4. Cleaning of air filters.
 5. Adjustment of video monitors picture controls.
 6. Tuning of video camera views (i.e., focus, iris).
 7. Configuration and through-put tests of system network (i.e., network switches)
 8. Inspection of cables and connections.
 9. Inspect and test all UPS units, including batteries and cables.
- C. Service response requirements shall include the following:
1. Twenty-four (24) hour phone number to reach in-house troubleshooting personnel.
 2. Ability to restore functionality within eight (8) hours after notification on a twenty-four (24) hour basis.
 3. Service technicians trained by the manufacturers of the system components.
 4. Provide remote support within a four hour response time during regular business hours - 7am – 6pm, Monday – Friday, excluding holidays.

PART 2 - PRODUCTS

- 2.1 Refer to appropriate Division 28 section for specific product information.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check location, “roughing in”, and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as indicated on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS

- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system.

3.3 SOFTWARE SUPPORT

A. PHASE I

1. Within three (3) months of receiving the approved shop drawing submittal, the SCSC shall request in writing a preliminary meeting with the Owner/Architect to discuss and demonstrate his working VGUI, programmed ‘In-House’ for the specific operations and functions of this project’s Security Control System. SCSC shall coordinate any proposed dates directly with the Architects Security System Specialist before any formal proposal or acceptance of dates by the GC. Also the SCSC shall present an extensive outlined analysis of all his ‘In-House’ software’s performance possibilities and their potential ap-

plications and/or approval to be utilized on this project. Refer to paragraph 1.5.C.4 of this section for the 'VGUI Screens' shop drawing submittal requirements.

2. The SCSC shall prepare a detailed report summarizing all software design and function criteria to be submitted to the Owner/Architect for approval by appropriate parties no later than two weeks after the date of the Phase I meeting. The custom software that operates the security control system shall be designed specifically from this document.
3. The Phase I meeting shall outline the requirements of the custom software as it relates to integrating all the individual components and devices making up the Security Control System (VGUI, VMS, Intercommunications, Alarms, Locks, etc.)

B. PHASE II

1. Prior to the scheduled date for job site delivery of the VGUI control stations, the SCSC shall request a second meeting with the Owner/User and Architect/Engineer at their manufacturing facility. SCSC shall coordinate any proposed dates directly with the Architects Security System Specialist before any formal proposal or acceptance of dates by the GC. The SCSC shall provide a full demonstration of the completed control consoles with a fully functional simulation of all the security control system software. The design and function of the 'In-House' software shall match the exact performance as specified in the detailed Phase I report. The SCSC shall include in their bid all expenses (travel, per diem, hotel and food) for four (4) owner representatives and two (2) architect representatives to attend the factory testing of the systems for a two (2) day period.
2. All deviations in the performance of the hardware or software shall be documented during this meeting, by the Architect/Engineer and SCSC, on a "pre-punch list". This "pre-punch list" shall be 100% corrected by the SCSC prior to delivering the equipment to the job site. Any additional comments shall now be incorporated.
3. During this time period, the SCSC shall perform all tests and critical conditioning on the security system to prepare the detailed diagnostic information and operational procedures for the service/operations manual.

C. PHASE III

1. Immediately following the installation of the security control system, the SCSC shall work with the Owner, the facility personnel, and the Architect/Engineer to correct any hardware problems or operational deviations from the original Phase I software design document. The SCSC shall modify the hardware/software as necessary to solve any problem resulting from poor installation.
2. Upon achieving a 100% functional security control system as determined by the Architect/Engineer, a documented release form provided by the SCSC shall be signed by the Owner and retained on file with the Project Manager. The SCSC shall continue to work on the installed hardware/software at no cost to the Owner or Architect/Engineer until the Owner's satisfaction is obtained by fulfilling the Phase I, II, and III document and a system release form is filed.

3.4 SPARES FOR ALL SECURITY CONTROL SYSTEM SECTIONS

- A. Each system provided by SCSC shall be built with the space, capacity, headend equipment and licenses to expand by 15 percent above those indicated for work of this project.
- B. Provide the following shelf spares:

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1. Provide one (1) PLC of each type used.
2. Provide one (1) PLC input and one (1) PLC output module of each type used
3. Provide one (1) PLC system power supply
4. Provide one (1) Power supply of each type used
5. Provide one (1) Duress station of each type used
6. Provide one (1) Card reader and one (1) Keypad/Card Reader of each type used
7. Provide one (1) Intercom station and one (1) Intercom master station
8. Provide one (1) Speaker (ceiling mount) with baffle and one (1) wall mount Speaker
9. Provide two (2) pre-programmed Fixed cameras and one (1) pre-programmed Multi-lens and PTZ camera with licenses of each type used.
10. Provide one (1) 24" VMS video monitor.
11. Provide one (1) 24" VGUI station with PC fully loaded with software for plug-and-play operation when an officer station VGUI/computer goes down.
12. Provide ten (10) relays, terminals, and fuses of each type used.
13. Provide one (1) spare of each type of surge protector.
14. Provide one (1) spare Glass Break sensor of each type used.
15. Provide two (2) hard drives of type installed on this project for video archive storage.

END OF SECTION 285000

SECTION 285010 – PLC, NETWORK, AND UPS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. The security control system shall be comprised of one or more programmable logic controllers and operator interfaces. The system shall include but not limited to, remote I/O, power supplies, input modules, output modules and any other required equipment to provide a fully functional system. The system will receive discrete inputs, and through the use of an internal control logic program, control output relay operations and perform remote control functions via the video graphic user interfaces.
- B. Provide labor, equipment, materials and supervision to install, program, calibrate, adjust, document, and test the total system as required herein, as shown on the drawings and required for the complete integration of the security system.

1.3 CONTROL, MONITORING, AND ANNUNCIATION

- A. The security control system shall control all electrically operated door hardware, monitor all doors position and bolt position limit switches, annunciate all door status and alarms. Lighting and receptacle control, intercommunication, paging, duress and video management control shall be integrated into the security control system. As part of video graphic user interface system, provide an integral security management system that shall record to disk, all occurrences of the system. Provide video graphic user interface terminals and security management system computers at locations as requested in the contract documents.
- B. The PLC System provides the logic control for the Security Control System. Unless noted otherwise, all user-initiated interfaces to the PLC system is performed through the Video Graphic User Interface (reference Section 285020). Critical control functions, such as door control and duress are to be executed by the PLC CPU program(s).

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEM

- A. General requirements
 - 1. Provide a Programmable Logic Controller (PLC) system that utilizes logic functions, memory, timing functions, software, I/O points, and communication capabilities for the control and/or monitoring functions of the systems described and shown in the contract documents.
 - 2. Each PLC shall be password protected against unauthorized entry to software.
 - 3. All components of the PLC system shall be by the same manufacturer, no mixing of multiple manufacturers shall be considered.
 - 4. Provide only UL Listed components.

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5. Provide a PLC System that seamlessly integrates the control system to the Local Area Network Hubs.
6. Provide CPU(s) with a visual status indication of backup battery.
7. Provide alarm in the event of CPU low battery voltage before battery failure.
8. Provide 15% spare PLC system capacity at the completion of the project. This includes program memory, I/O memory allocation, register memory, user memory, etc.
9. Provide programming that utilizes a simplistic logic format that can easily be modified by 3rd party vendors.
10. Provide 15% spare PLC I/O module capacity at the completion of the project. Calculate inputs and outputs separately when figuring capacities.
11. All PLC interposing relays must be fused to protect the relay and field device wiring from over-current caused by shorts or device failure.
 - a. Exception: Whereas the terminal block is in receipt of a dry contact from another system, a fuse isn't required on that portion of wiring.
12. PLC Central Processor Unit
 - a. Provide expansion chassis and power supply module with each processor assembly as needed.
13. PLC Digital Inputs and Outputs
 - a. Each input or output module shall be a self-contained unit.
 - b. It shall be possible to replace any I/O module without disturbing or removing user field wiring.
14. PLC Remote Inputs and Outputs
 - a. The remote I/O system shall be compatible with all of the modular I/O systems.
 - b. Power will be provided by the I/O rack assembly power supply.
15. Termination Labeling
 - a. Each wire will be labeled with an industry standard thermal transfer wire marker.
 - b. I/O wire number should reference wiring diagram and Software I/O list.
 - c. Felt tip pen labels are unacceptable.
16. The control architecture will use distributed control over the Ethernet network.
17. Local and remote networking shall be via dedicated interface modules providing serial communications at rates, which are selectable from 62.5K to 1M, bits per second. The interface modules shall be capable of I/O drops at distances of up to 7,500 feet and control up to 32 remotes.
18. The PLC shall have a communications card capable of communicating with an industry standard stand-alone computer.
19. Communication between the PLC and the computer(s) shall be a peer to peer network; no master station (central hub or server) shall be required.
20. Communication on the peer to peer network shall be a minimum of 50 K baud of data transmission.
21. There shall be no noticeable delay between any video graphic user interface icon or field device input and the resulting output on the video graphic user interface or in the field.
22. Door Monitoring and Control: Lock position and door position switches shall be wired as separate inputs to the PLC. The deadbolt switch will be wired as a separate input to the PLC as well as the door position switch a separate input to the PLC. When the door is locked and secure, the circuits shall provide voltage to the PLC. If either the LPS or DPS

circuits open the VGUI shall report the door as being open/unsecure. If the door is a sliding door or overhead door, then the open and close limit switch will be wired as separate inputs to the PLC and will not be part of the sliding or overhead door control circuits.

- a. Unless otherwise stated, all electrically controlled and/or monitored doors shall be connected and controlled and monitored by the PLC System.
- b. All electric locks shall be individually fused. Provide door control relays with indication light.
- c. Locks shall be controlled via mechanical interposing relays driven by the PLC. Solid-state relays are not acceptable. Provide all required power to control doors.
- d. Interlocks shall be implemented via PLC software. Any door shall have the ability to be programmed to become a member of an interlock scheme. The Architect and/or owner shall reserve the right to re-define interlocks during the submittal phase without additional costs to the owner.
- e. Upon a loss of power, faults or communication failures with PLC input and output modules or PLC CPUs, all electric locks shall de-energize (fail-secure). Sliding and overhead doors shall remain in their present state.

B. PLC Specifications:

1. PLC Central Processor Units
 - a. Processor to serve up to 2048 I/O points or more
 - b. Minimum 64K word instruction memory
 - c. RS-232 ASCII configurable auxiliary com port
 - d. Bit instruction execution time of 0.80 μ s max
 - e. Built in real time clock and calendar
 - f. Built in 100Mb or Gigabit Ethernet port
 - g. Battery backed EEPROM memory
 - h. Connectivity via Ethernet, Devicenet, Modbus RTU master/slave over RS-485 and RS-232-C.
 - i. Shock rating, operating – 30.0g (3 pulses, 11 ms)
 - j. Vibration rating – 1.0g @ 5-2000 Hz
 - k. Operating Temperature range – 32 to 140 Degrees F
 - l. Operating Humidity range 5 – 95% RH non-condensing
2. PLC Digital DC Input Modules
 - a. 10 – 30 VDC operating range
 - b. Sourcing or Sinking type modules
 - c. Maximum on/off signal 0.5mS max with selectable 1 or 7mS filter
 - d. Maximum off state current 0.5mA
 - e. 32 point modules minimum
 - f. Maximum backplane current load – 50mA
3. PLC Digital DC Output Modules
 - a. 10.2 - 30 VDC operating range
 - b. Sourcing or Sinking type modules
 - c. Maximum continuous current per output, .5 amp sourcing/1.0 amp sinking
 - d. Maximum continuous current per module, 8 amp sinking or sourcing @ 60° C
 - e. 32 point modules minimum
 - f. Maximum backplane current load – 90mA @ 5 VDC
 - g. Removable terminal blocks
 - h. Gold plated contacts

4. PLC Power Supplies
 - a. 120/220 VAC nominal input voltage
 - b. Maximum input power, 27 VA
 - c. Backplane output current, 1.5 amps total
 - d. Operating Temperature range – 0 to 60° C
 - e. Operating Humidity range 5 – 95% RH non-condensing
5. Acceptable Manufacturer
 - a. Allen Bradley
 - b. G.E. Fanuc
 - c. Omron
 - d. MTI
 - e. Or Approved Equal

2.2 LINEAR POWER SUPPLY

- A. Provide linear power supplies as required for control power.
 1. Specification
 - a. AC Input: 120 VAC, +10%, -13%
 - b. DC Output: 24 VDC (5A or 10A as required)
 - c. Line Regulation: +/- .05% for a 10% change
 - d. Load Regulation: +/- .05% for a 50% load change
 - e. Output Ripple: 3 mV peak-to-peak maximum.
 - f. Transient Response: 50 microseconds for 50% load change.
 - g. Short Circuit Protection: Automatic current limit/fold back
 2. Provide back plates, mounting hardware and all appurtenances required to install the power supplies in the system equipment racks.
 3. An individual homerun cable is required to each field device from the power supply. Do not loop-wire or daisy-chain power, or tap power conductors from a junction box. Device power will be part of the control wiring to the device
 - a. Exception: 120 volt continuous power wiring, such as exterior camera power
 4. The output of the power supply is to feed a series of fuses rated for the intended load. One each per homerun cable/device load
 5. Acceptable Manufacturer
 - a. Phoenix Quint-series
 - b. Sola
 - c. Power One
 - d. Or Approved Equal

2.3 RELAYS AND TERMINALS

- A. Relays - General
 1. The relays shall provide actual switching of power to electric locking hardware, lights, etc.
 2. All relays shall be of electro-mechanical type and be standard off-the-shelf commercially available components.
 3. Relays and terminals for each device shall be grouped together, and each terminal shall be labeled.

4. Relays shall be pluggable with diode protection across coils and LED indication of activated coil circuit.
 5. Each relay contact to the control device shall be individually fused.
 6. Low voltage wiring in relay cabinet shall be separated from high voltage wiring and all wiring shall be color-coded and marked with approved wire markers.
 7. Control wiring shall be routed through plastic wire duct and landed on terminal strips.
 8. Relays shall be controlled directly by the PLC.
 9. Peripheral interface cards with active circuitry will not be approved.
 10. SPST or DPDT as required. The relays will perform the actual switching of the power to the locks. Electric locks shall not be controlled directly by the PLC.
 11. Acceptable Manufacturers:
 - a. Idec
 - b. Potter and Brumfield
 - c. Phoenix Contact
 - d. MTI
 - e. Or Approved Equal
- B. General Purpose Relays
1. Specifications
 - a. Switching Capacity: 6 Amp continuous, 8 Amp inrush.
 - b. Duty cycle: 100%
 - c. Termination: Screw Connection
 - d. Operating Indicator Light, Damping diode, polarity protection diode
 - e. Operating Voltage: 24 VDC
 - f. Temperature: -20 C to 55 C
 - g. DIN Rail Mountable Socket
- C. Special Purpose Relays (High Power)
1. Specifications:
 - a. Relays contacts shall be U.L. listed for a continuous current of 10 amps (inrush of 16 amps)
 - b. Termination: Screw compression
 - c. Operating Indicator Light
 - d. Coil Rated Current: < 70 ma
 - e. Operating Voltage 24 VDC
 - f. Max. Cont. Applied Volt: 110%
 - g. Drop-out Voltage: 10%
 - h. DIN Rail Mountable Socket
- D. Fuses Terminal Blocks
1. Specifications
 - a. Din Rail mountable IEC style (if external from Relay boards)
 - b. Should be dead front safety (ie. touch safe)
 - c. Screw clamp and Spring Clamp are acceptable
 - d. All Fuse terminal blocks will be sized accordingly to the wire gauge and current load required for the application.
 - e. Provide lever disconnect type IEC fuse blocks.
 2. Acceptable Manufacturer

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- a. Allen Bradley
 - b. Phoenix Contact
 - c. Square D
 - d. Or Approved Equal
- E. Modular Terminal Blocks
- 1. Specifications
 - a. Din Rail mountable IEC style (where external terminal blocks are needed)
 - b. Dead front safety (ie. touch safe)
 - c. Screw clamp and Spring Clamp type acceptable
 - d. All terminal blocks will be sized accordingly to the wire gauge and currents load required for the application.
 - e. Safety grounds should be identified with yellow/green color.
 - f. One wire per termination point unless Ferrules are used for special applications
 - g. All ferrules are to be crimped using the manufacturer's recommended crimping tool.
 - 2. Acceptable Manufacturer
 - a. Allen Bradley
 - b. Phoenix Contact
 - c. Square D
 - d. Or Approved Equal
- F. I/O Boards
- 1. Input boards shall be optically isolated and designed to accept an input signal of 24 volts AC or DC. These boards shall be capable of rack mounted. Each input point shall have a corresponding LED indicator which illuminates when the input is read as on by the microprocessor. These boards shall be configured in a minimum of 16 inputs.
 - 2. Output boards shall be reed relay outputs with ability of isolated commons. These devices shall be capable of rack mounted. Each output shall be fused and be accompanied by a LED indicator which illuminates when the processor issues a command to energize the output, and a second LED to indicate the condition of the fuse. These boards shall be configured in a minimum of 16 outputs.
 - 3. Boards combining inputs and outputs on the same board will be acceptable provided they meet the requirements listed above.

2.4 SECURITY LOCAL AREA NETWORK

- A. Provide an independent secure Local Area Network (LAN) that shall include connections between the PLC system, graphic user interfaces, intercommunications/audio system, video management system, card access, and other integration system CPUs.
- B. The LAN shall be a high speed, fault tolerant, self healing Ethernet industrial communication network. It shall be a tree topology using fiber optic media as required and be in compliance with IEEE 802.3.
- C. The Ethernet Network shall consist of CAT6 UTP cable within the structure for distances less than 100m.
- D. Ethernet UTP shall be run without splice unless terminated through the appropriate patch using RJ-45 connectors or approved punch down blocks.
- E. Fiber Optic shall be used:

1. For the network backbone
2. Between structures
3. Any application beyond the building walls (exterior)
4. Distances over 100m

F. Network Fiber Optic transceivers shall be integral to the network scheme, utilizing SFP or mini-GBIC technology for the network backbone between switches. Separate converters will not be allowed for Ethernet backbone.

1. Fiber Optic connectors shall conform to the device served without the use of adapters.
2. Terminate all unused fibers in a patch panel using correct and consistent labeling at both ends.

2.5 NETWORK SWITCHES

A. Provide switches for the IEEE802.3a-f 10/100/1000 BASE-T Local Area Network connectivity and 1 Gigabit minimum uplink capability. Provide stackable switches for faster uplink speeds.

1. 24 RJ-45 ports minimum (Switches shall be sized as required)
2. Auto crossing, auto negotiation
3. LEDS: Link Integrity and Status, Link speed, RPS, PoE
4. PoE (power over Ethernet) capable, with up to 30W per port
5. 370W or 740W fixed power supply option
6. Operating Temp -5°C – 45°C
7. 100 – 240 VAC, 50 to 60Hz, 5A max
8. 19" Rack Mountable

B. Acceptable Manufacturers

1. Cisco
2. HP
3. Approved Equal

2.6 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. This section defines the electrical and mechanical characteristics and requirements for a continuous-duty single-phase, solid-state, uninterruptible power system. The UPS will provide high-quality AC power for sensitive electronic equipment loads.

B. Ratings

1. 120 Volt Nominal Units, Single Phase
2. UL Standard 1778
3. NEMA Type 1 Enclosure
4. FCC Part 15, Class A

C. The SCSC shall supply UPS power at each Security Electronics room, sized to provide adequate and protected power for the loads served.

D. Submit a list of loads showing the ratings (amps, watts, volts) and the time-wattage charts for the UPS. The list shall include a side bar showing the BTU-hr heating effects of the equipment

- in the control rooms and equipment room. Include the BTU-hr heating effects of the selected UPS.
- E. Provide the size and quantity of UPS units required to support the attached load to be served plus an additional 20% headroom.
 - F. Provide a UPS at each rack, cabinet and VGUI. The UPS shall have sufficient battery capacity and charging capacity to operate all security system equipment (to include VGUI(s), SMS, PLC system, all door monitoring, audio system, camera system and digital video recording system) for a period of 5 minutes at full load without degradation to the system. Only rack mounted UPS systems may be used in equipment rack or console locations.
 - G. Devices with built in battery backup such as door lock power supplies or card access panels do not require a separate UPS. UPS or battery power is not required for door lock power supplies.
 - H. The UPS system shall interface with the PLC System providing indication of "UPS trouble" status of the unit(s). Provide interface to Central Control to monitor both alarm and trouble signals from each UPS.
 - I. Where the total number of circuits required for UPS-fed apparatus from any individual UPS unit that feeds a main or remote rack exceeds six circuits, the SCSC shall furnish and install a minimum of a 100 ampere main-breaker panelboard.
 - 1. The panelboard shall be rated for the required load, but at a minimum it shall be 100A bus with 60A Main Breaker, 120/240V, 10K AIC, single phase, three wire, with ground bus, and furnished with a minimum of (8) one-pole 15 or 20 amp bolt-in circuit breakers installed.
 - J. All UPS branch circuitry, inclusive of the main distribution panelboard, must be installed by a licensed electrical contractor with journeyman electricians in attendance. If requested, the SCSC must provide proof of expertise.
 - K. The UPS is designed to operate as a true on-line double conversion system in the following modes:
 - 1. Normal - During normal operation, utility power provides energy to the UPS. The filters, the power factor correction circuit and the inverter process this power to provide computer-grade power to connected loads. The UPS maintains the batteries in a fully charged state.
 - 2. Battery - The UPS will enter Battery mode if there is an extreme power surge, extreme power drop, or utility failure. The battery system supplies power through the DC-to-DC converter to the inverter to generate computer-grade power for the connected load.
 - 3. Recharge - Once utility power is restored, the UPS resumes normal operation and the Battery Charger begins recharging the battery.
 - 4. Bypass - Bypass mode provides an alternate path for utility power to the connected load in the unlikely event of a UPS malfunction, such as overload, overtemperature, or an internal circuit failure.
 - 5. Automatic Restart - Upon restoration of utility / mains AC power, after a utility mains AC power outage and complete battery discharge, the UPS automatically restarts and resumes supplying power to the critical load and the battery charger automatically recharges the battery.
 - L. Design Requirements

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1. Voltage: Will operate at either 120/208V or 120/240V by sensing the utility phase angle and configuring the dual inverters to the same angle: 120 or 240 degrees, (or) 180 degrees. Coordinate power requirements with EC during submittal phase.
 2. Nominal input/output voltage specifications of the UPS at rated load are:
 - a. The UPS will operate on voltage ranging from 120/208V, 60/50 Hz, (or) 120/240V, 60/50 Hz without the use of selector switches or voltage taps. Input wiring must be 3-wire (L1, L2, N) -plus-ground. The output voltage is automatically set to match input voltage.
 3. Output Load Capacity: Specified output load capacity of the UPS is:
 - a. 6000 VA/4200Watts at 0.70 power factor for 120/208V and 127/220V with all L-N loads
 - b. 5200 VA/4200 Watts at 0.81 power factor for 120/208V and 127/220V with all L-L loads.
 4. Internal Battery: Valve regulated, non-spillable, lead acid cells.
 5. Reserve Time: 4200W minimum 5 minutes with ambient temperature of 77°F (25°C).
 6. Battery Recharge: The UPS contains a battery recharge rate designed to prolong battery life. Recharge time for UPS internal batteries is six (6) hours maximum to 90% capacity after a complete discharge into full load.
 7. Input Line Transient Immunity: The UPS withstands input line transients in compliance with IEEE c62.41, Category A and
 8. Surge Protection: The UPS utilizes MOV ratings will be 175 Volt, 150 Joules minimum connected L1-N and L2-N; 300 Volt, 150 Joules minimum connected L1-G, L2-G and N-G
 9. Battery Mode Neutral Grounding: UL1778 requires each input pole to be disconnected from the source during battery operation. The patented design of the UPS includes a relay to bond the output Neutral to Ground during battery mode operation to prevent a floating output neutral during battery mode operation.
- M. Environmental Conditions
1. Ambient Temperature: + 32°F to + 104°F (0°C to +40°C) for altitudes 0 to 5,000 feet (0 to 1500 meters) above sea level. + 77°F (25°C) for optimum battery performance.
 2. Relative Humidity: 0 to 95% non-condensing.
 3. Storage: 0 to 95% non-condensing.
 4. Audible Noise: Noise generated by the UPS under normal operation does not exceed 55dBA when measured at 1 meter from the surface of the UPS.
 5. Electrostatic Discharge: The UPS is able to withstand an electrostatic discharge compliant to EN61000-4-2, level 4, Criteria A, without damage and will not affect the connected load.
- N. The UPS unit is comprised of the input PFC converter, battery charger, dual-inverter, input filter, automatic bypass circuit, housed in a rack - tower NEMA type 1 enclosure
- O. The UPS shall meet the requirements of IP20.
- P. The UPS is forced air cooled by internally mounted continuous fans. Fan power is provided from the internal DC supply. Air intake is through the front of the unit and exhausted out the rear of the unit.

- Q. Converter: Incoming AC power is converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter provides input power factor correction (PFC) and input current distortion reduction.
- R. AC Input Current Limit: The input will use whatever power is needed to power the output overload specification before going to batteries. The UPS does not use electronic input current limiting. The UPS includes a 2-pole switch-type 30A input breaker.
- S. Input Protection: The UPS has built-in protection against undervoltage, overcurrent, and overvoltage conditions including low-energy lightning surges, introduced on the primary AC source. The 208 VAC models can sustain input surges without damage per criteria listed in ANSI C62.41 Cat. A & B.
- T. Battery Recharge: The UPS contains a battery recharge rate designed to prolong battery life. The battery is constant current charged to restore capacity, then shall be constant voltage charged to maintain the battery in a fully charged state. Recharge time for the internal battery shall be six (6) hours maximum to 90% capacity (full load discharge rate). There is DC overvoltage protection so that if the DC voltage exceeds the pre-set limit, the inverter will shut-down automatically and the critical load will be transferred to bypass.
- U. Other General Features:
 - 1. The UPS inverters are a pulse-width-modulated (PWM), IGBT design capable of providing the specified AC output. The inverters convert DC power from the input rectifier output, or the battery, into precise sinewave AC power for supporting the critical AC load.
 - 2. Overload: The inverter is capable of supplying current and voltage for overloads exceeding 100% and up to 201% of full load current. A visual indicator and audible alarm indicates overload operation. For greater currents or longer time duration, the inverter has electronic current-limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load without the requirement to clear protective devices.
 - 3. Inverter DC Protection: The inverter is protected by the following DC shutdown levels:
 - a. DC Overvoltage Shutdown
 - b. DC Undervoltage Shutdown (End of Discharge)
 - 4. Output Frequency: An oscillator controls the output frequency of the UPS. The inverter maintains the output frequency to + 0.1 Hz of nominal frequency during battery mode, frequency converter mode, or when otherwise not synchronized to the utility/mains source.
 - 5. Output Protection: The UPS inverter employs electronic current limiting circuitry for protection during normal mode and battery operation, and input circuit breaker protection during bypass mode operation.
- V. Display and Controls
 - 1. General: The UPS is provided with a microprocessor-based control and a status display section designed for convenient and reliable user operation. The monitoring functions such as status and alarm indicators are displayed on a front-panel LED display.
 - 2. System Indicators: The UPS includes five individual LED status indicators, and three rows of LED's to indicate UPS load and battery capacity. An audible alarm will be used

in conjunction with the visual indicators to indicate to the operator a change in UPS operating status.

3. All audible alarms can be silenced, with the exception of low battery, bypass reminder, and missing batteries at startup alarms. Once silenced, the audible alarm will not sound until a new alarm condition is present. Standard LED indicators are described below:
 - a. Load Level indicators – 10 total: 4 green and 1 amber, for each of the L1 and L2 outputs. The Load Level indicators display the approximate load level at all times.
 - b. Battery Capacity indicators - 5 green LEDs. The Battery Capacity LEDs display the approximate level of battery reserves.
 - c. Fault indicator - 1 red LED. The Fault indicator LED illuminates if the UPS detects an internal problem. One or more of the Battery Capacity indicators may be illuminated to aid in diagnostics.
 - d. AC Input indicator - 1 green LED. The AC Input indicator LED is illuminated when utility power is available and falls within the input specification.
 - e. UPS ON indicator - 1 green LED. The On Inverter indicator LED is illuminated when the UPS inverter is operating and supplying power to connected loads.
 - f. On Bypass indicator - 1 amber LED. The On Bypass indicator LED is illuminated when the bypass source is supplying power to connected loads.
 - g. On Battery indicator - 1 amber LED. The On Battery indicator LED is illuminated when the AC Input is out of the acceptable operating range.
4. On-Standby-Off Controls: UPS start-up and shutdown operations are accomplished by the "ON" and "STANDBY" push buttons located on the front panel of the UPS. The "ON" push button is a means to turn the UPS on and also serve as a means to manually test the battery. The "STANDBY" push button allows manual transfers of the load from the inverter to bypass power. Pressing the "STANDBY" push button, in bypass mode or battery mode, will completely shut down the UPS and its connected load.
5. On-Line Battery Test: The UPS features an automatic battery test with the factory default test interval set at every 2 weeks. The battery test will ensure the capability of the battery to supply power to the inverter while loaded. If the battery fails the test, the UPS will display a warning alarm to indicate the internal batteries need replaced and resume operation without disturbing the load. The battery test feature is user accessible by the push button located on the front of the unit.

W. Bypass

1. General: A bypass circuit is provided as an integral part of the UPS. The bypass shall have a make-before-break transfer, will have a maximum detect and transfer time of 4-6 milliseconds, and be a double-pole device. The bypass circuit is designed to ensure the simultaneous transfer of the L1 and L2 poles.
2. The bypass is configured to wrap around the PFC converter, battery charger, DC-DC converter, inverter, and battery. The bypass circuit will use the rear-panel mounted UPS input circuit breaker and route bypass power through the UPS input filters and surge suppression circuit. The bypass circuit default position is in the bypass mode (utility).
3. Automatic Transfers: The transfer control logic automatically activates the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:
 - a. UPS overload
 - b. UPS over temperature

- c. PFC failure
 - d. Inverter failure
 - e. DC Bus Overvoltage
4. Once overload condition is reduced, the load is automatically transferred back to inverter power. An over temperature requires manual transfer back to inverter power after cooling.
- X. Maintenance Bypass Switch
- 1. The unit shall be installed on all UPS units over 4KVA.
 - 2. Similar units will be required for rack-mounted UPS units of 1.5KVA and 3KVA
 - 3. The unit allows the ability to take the UPS off-line (transferring to normal power) so the UPS can be serviced.
 - 4. Unit shall be UL1008 listed
 - 5. Manually initiated electrical operation
 - 6. The unit shall have high interrupting ratings, current ratings at 100%, and a solid neutral
 - 7. Pilot lights will indicate NORMAL or BYPASS
 - 8. This external maintenance bypass switch is a MBB (Make Before Break) switch with a locking handle. It must be mounted on the wall near the UPS.
- Y. Internal Battery
- 1. Valve regulated, non-spillable, lead acid cells are used as a stored-energy source for the specified UPS system. The battery kit is internal to the UPS cabinet, and sized to support the inverter at rated load and power factor, with ambient temperature of 77°F (25°C) for a minimum of 5 minutes reserve time. The expected life of the battery shall be 3 - 5 years or a minimum 250 complete discharge cycles at ambient temperature of 77°F (25°C). To promote battery service life and eliminate over-discharge of the battery, the end-of-discharge DC shutdown voltage will be automatically adjusted by the microprocessor based upon the percentage load at the onset of battery operation.
- Z. Output Distribution
- 1. Output distribution is integral to the UPS cabinet, and located on the rear of the unit. The output distribution shall provide the capability to re-configure the UPS input and output connections via a removable sheetmetal power distribution box. Distribution options shall be available with break-before-make maintenance bypass switch to allow for complete shutdown and isolation of the UPS for service without powering down the connected loads. Maximum transfer time of the maintenance bypass switch shall be 4-6ms
- AA. Communication Options
- 1. UPS shall have a DB-9 Serial Port (9 pin female) connector on the rear panel to provide UPS status communications. The UPS will communicate via serial communications using Liebert ESP II protocol. The DB9F will also include photo-couplers to signal "on battery" and "low battery" operational status. The UPS will be capable of receiving a signal from the connected host system to initiate a UPS shutdown, when operating from battery power. This signal will be a +5V to +12V level that must remain for at least a 1.6 second duration.
- BB. Acceptable Manufacturers
- 1. Liebert
 - 2. Eaton

3. APC
4. Cyber Power
5. Or Approved Equal

2.7 SURGE/LIGHTNING PROTECTION

A. General

1. All data, power, audio and video signal cables entering the facility from a point exterior to the building shall be equipped with a silicon avalanche diode type of lightning protection.
2. Surge Protection Devices (SPDs) shall be supplied by an ISO 9001:2000 certified company in the business of manufacturing.
3. Product data submittals shall include 8/20 μ s rated surge capacities, relevant IEEE and IEC specifications, installation instructions, and operating characteristics.
4. Mounting guidelines will be followed as indicated in installation instruction provided by manufacturer.
5. Protector shall be located at the first cabinet through which the cable or conductor passes upon entering the building.
6. The SPD shall be mounted as close as possible to the equipment or service being protected.
7. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.
8. The SPDs shall have integral mounting brackets to attach to 35mm DIN rail conforming to DIN EN50022. The mounting bracket of the SPD shall make ground connection to the DIN rail; therefore, minimizing ground impedance connections. The DIN rail and enclosure will be electrically grounded. For installations requiring a high number of SPDs in a single cabinet, a 19" rack mount SPD with provisions for 4 to 24 channels of protection will be acceptable.

B. Surge Protection Devices For 120v AC Power Circuits

1. 120VAC surge protection devices shall be installed on each non-UPS or emergency circuit feeding security devices.
2. The SPD shall be UL listed or recognized to UL 1449, 2nd edition.
3. SPDs for single phase equipment shall be designed to withstand up to a 10kA test current of a 8/20 μ S waveform according to IEC 1024 Application Guide A and IEEE C62.41.1-2002 Category C area.

C. Surge Protection Devices For Ethernet Data Networks

1. SPDs shall be designed for protection of transmission of Fast Ethernet (100Mbps) over Category 5e cable as a minimum.
2. The protection circuit shall have fine protection diodes between all the signal wires, as well as coarse protection between shield and ground.

D. Acceptable Manufacturers

1. Phoenix Contacts
2. Approved equal

PENDER COUNTY LAW ENFORCEMENT CENTER
BURGAW, NORTH CAROLINA
Architect's Project No: 611888

END OF SECTION 285010

SECTION 285020 – VIDEO GRAPHICAL USER INTERFACE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. This section contains the requirements and operational characteristics for a security control system. The system shall feature video graphical user interface(s) (VGUI) as shown on the plans allowing control for the automated security control system. The Control functions to be initiated by the VGUI include, but are not limited to the following:
 - 1. Door control and monitoring.
 - 2. Interface between intercom stations and speaker output selections.
 - 3. Interface between video surveillance system alarm inputs and monitors.
 - 4. Interface between the control of power circuits for lighting, outlets, and solenoid valves for plumbing.
 - 5. Interface, control and monitoring of card readers, push buttons, and duress stations.
- B. System shall also include a Security Management System (SMS) which shall operate as separate terminals as shown on the plans. The system shall provide administrative viewing and retrieval of database information. Data stored within the database shall be stored in Windows-compatible files for exportation and report generation.

1.3 OPERATIONAL DESCRIPTION

- A. General Description - The VGUI display shall be divided into three main sections; the Map Display, the Site Map and the Function Control Bar (FCB).
- B. The Map Display is the main section on the left of the monitor screen displaying a 2-dimensional view of a selected area in the facility. Each view is referred to as a "Map". The Maps shall have graphic icons representing all monitored and controlled devices placed on the floor plan in their approximate location. The graphics shall optimize the use of screen resolution and color to enhance and simplify the information displayed. Each operator station located in open dayrooms shall have an "Emergency Disable" Icon, red in color that shall allow the operator of that station to shut down the operator station if under duress located in the top left hand corner of the Map Display area. By disabling the operator station, Central Control has taken over the capabilities of this station. Central Control will be required to re-enable the station once the duress situation has been resolved.
- C. PTZ controls shall be provided on the Screen when PTZ cameras are used.
- D. The Site Map is the section of the screen that is used to navigate between maps and view the other areas of the facility. The operator shall select an area in the Site Map by clicking on the area with the mouse/touch point. The area will be highlighted in white

in the Site Map and be displayed in the Map Display area. The time duration to generate any screen within the VGUI shall not exceed one ½ second. The Site Map area shall have an Intercom Call Pending List Display that shall display all current incoming intercom calls. In order to perform a function, the operator must select an intercom call. Once the intercom is selected the station shall be connected to the intercom master station as well as display the area on the Map Display where the call was originated. The Site Map area shall also have an Active Call Station Display that will be activated when an operator selects an intercom call.

- E. The FCB section of the monitor screen is used to control devices in the facility. Door control functions shall require a two-step operation. The two-step operation is to protect the operator from accidentally opening a door. The operator will select a function Icon in the FCB and then select a Door Icon for a normal door unlock.
- F. The FCB shall have a “Utility” Icon. The Utility control is a hidden function on the VGUI screen, therefore, the operator will not see any utility Icons on the Map Display until the Utility Icon in the FCB is selected. Once the Utility Icon is selected the utilities alone will display graphically on the Map display for three seconds. If a Utility Icon on the Map display is not selected within three seconds the command cancels, and the previous Map will be displayed. Activating a utility shall be done by selecting the appropriate Icon on the Display map. When a utility has been selected or turned on, the Icon symbol will change to a yellow color and will stay yellow until it is selected again/turned off.
- G. Included in the Central Control operator control panel is a PLC Status Icon that will allow the operator to check the state of all the PLC modules in the facility. The PLC modules shall be grouped by PLC equipment cabinet or rack in black print and will be highlighted in red print if offline.
- H. In the event a PLC or PLC module does go offline, a pop up will appear on the screen which will allow the operator to go directly to the PLC status screen.
- I. Central Control shall have the ability to view all screens of the facility with status of all doors, and alarm conditions regardless of which VGUI has primary control of those devices. No device or door shall be controlled by two operator stations simultaneously.
- J. Icons for doors, intercoms, cameras, etc, which are under primary control of Central Control (i.e. movement doors, exterior doors for sally ports, etc.) shall be displayed as standard icons as described in the sections to follow and can be controlled by Central Control.
- K. Icons, which are under primary control of the local VGUI, shall appear on these same Central Control screens as ‘sunken’ into the screen with a passive or reverse video color. The status of the door position switch (DPS) and lock position switch (LPS) shall be dynamically displayed as described in the sections to follow for both primary and secondary door icons. The intent is to allow Central Control to be aware of door movement in pods, booking areas, etc, while leaving control of those doors with the local VGUI.
- L. Local VGUIs shall display icons of doors, intercoms, cameras, etc, which are under primary control of Central and shall appear on these same local VGUI screens as ‘sunken’ with a passive or reverse video color. The intent is to allow the local VGUI to be aware of door movement in & out of Pod movement doors, booking area’s

movement doors & exterior sallyports and the vehicular sallyport, etc, while leaving control of those doors to Central Control.

1.4 VIDEO GRAPHIC USER INTERFACE EVENT SUMMARY

- A. An event-based strategy shall be applied to the development of the VGUI screens. Color utilized in the screen development shall be neutral gray in nature. Events shall be exceptions to the screen and shall be highlighted both visually using color. Owner shall be able to change color designations at no additional cost.
- B. The system shall also incorporate the use of voice announcements and beeps and chimes so that all operator actions, system warnings and emergencies and other important information are announced to the operator. Alarm announcements shall be displayed until they are acknowledged, regardless of screen display. The operator will not have to wait for the sound to be completed before proceeding to other screen functions unless it is an emergency function.

1.5 ALARM PRIORITIES

- A. As part of the VGUI, provide priority alarms and calls associated with different events and icons. Prioritization of alarms shall be limited to a total of seven levels. The Owner reserves the right to provide two additional priority levels or change the priority levels listed below during the Phase I software writing process.
 - 1. Level #1: Duress Alarms
 - 2. Level #2: Breach of interlocked Sally Port
 - 3. Level #3: Door Alarms
 - 4. Level #4: Intercom calls
 - 5. Level #5: Inmate cell intercom calls

1.6 LOG IN

- A. Each graphical user interface station has a log in screen when the station is enabled from Central Control. The user must input a valid username and password combination to gain access into the system. Each user will have a particular level of access – administrator, supervisor, user.
- B. To change the door shunt feature, hold open alarm, intercom isolate feature, and the auto log off timer, the individual logged on must have supervisor level privileges.
- C. Each operator station that is not located in a secure control room will have an auto-log off feature. If the operator has not performed a function in a configurable amount of time, the system logs off and rolls to Central Control.

1.7 DEVICE ICONS

- A. The VGUI shall have Device Icons located in the Map Display including, but not limited to Door Icon, Intercom Icon, Camera Icon, Page Zone Icon, Duress Icon, Card Reader Icon and Group Control Icon. All maps shall be sized to allow for icons that measure 3/8" x 3/8" or larger when measured on actual monitor. Provide at least 1/8" separation between icons. The VGUI shall also have Function Icons located in the FCB

including Unlock Icon, Stop Icon, Hold Open Icon, Door Isolate Icon, Intercom Isolate Icon, Interlock Override Icon, All Page Icon, Silence, and Reset Icon.

1.8 DOOR CONTROL

- A. The steps required to open a swinging, sliding or overhead door are the same. The operator will first select the Unlock Icon in the FCB and then within three seconds, select the Door Icon in the Map Display. Other doors may be commanded to unlock by selecting other Door Icons within the three seconds of the first.
- B. To stop motion of a sliding or overhead door the operator will select the Stop Icon in the FCB.
- C. Door Status Alarm Indication:
 1. Unauthorized Access / Breach:
 - a. All controlled doors shall provide an unauthorized or breach alarm to the VGUI anytime a door opens by any means (such as forced or keys) that is not authorized by the security electronics control system (VGUI, PLC, card access).
 - b. Monitored only doors do not provide unauthorized access or breach alarms unless otherwise noted in the drawings.
 - c. Unauthorized access or breach alarm door breaches shall be programmed as a standard default feature and not provided as an option.
 2. Door Held Open / Door Prop:
 - a. All controlled and monitored doors shall provide an alarm to the VGUI anytime a door is held open beyond a configurable amount of time, unless otherwise noted in the drawings.
 - b. The alarm can be silenced, reset and removed from the queue even if the door has not been re-secured. Every day that the hold open alarm is not resolved (a secure indication for that door has not been received into the system), a new hold open alarm for that door shall come into the VGUI.
 - c. Door held or prop alarms shall be programmed as a standard default feature and not provided as an option.
- D. The Door Icons in the Map Display shall have a graphical representation of the door. It shall provide a graphical difference between the LPS and DPS conditions. If either the LPS or DPS circuits open the VGUI shall report the door as being open/unsecure. If it is a swinging door it depicts the door swing and if it is a sliding or overhead door it shall depict the door as secure, in mid travel or fully open.
 1. The Door Icon is gray and the door graphic is gray and is shown closed when the door is locked and secured.
 2. The Door Icon is gray and the door graphic is red when the door is powered and opened.
 3. The Door Icon is gray and the door graphic is fast flashing red when the door is breached or manually opened.
 4. The Door Icon is gray and the door graphic is slow flashing red when the door alarm has been acknowledged by the operator.
 5. The Door Icon is gray again and the door graphic is gray again when the door has been reset by the operator.

6. If there is a camera associated with door in alarm it shall be displayed on the call up monitor and the Camera Icon shall change to red.
 - E. Interlocked doors are bordered around their Icons in yellow when a door in a designated interlock group is unsecured. If two interlocked doors are attempted to be unlocked at the same time, a pop up warning shall display on the screen along with a voice announcement.
- 1.9 DOOR SHUNT
- A. Each controlled or monitored door will have the ability for the door breach alarm to be shunted. The door breach alarm does not alarm to the graphical user interface when the door has been shunted.
 - B. The door shunting feature shall be configurable by individual door by a supervisor level user.
 - C. Door icon shall display an "S", a change in color, or similar graphic change to signify when the alarms are shunted.
- 1.10 HOLD OPEN
- A. Selecting the Hold Open Icon in the FCB will unlock the door and keep it electrically unlocked until the operator selects the Door Icon only. The Function Icon in the FCB shall stay illuminated during the three second selection process.
- 1.11 DOOR ISOLATE
- A. Electrically controlled doors or doors that are controlled by card readers can be isolated so that they cannot be opened. To isolate a door the operator selects the Door Isolate Icon in the FCB and then selects the Door Icon. Other doors can be isolated within three seconds of the first. After three seconds the Door Isolate function cancels. Repeating the process on the same Door Icon will reverse the condition. When a door is isolated the Door Icon will have a black "X" over it indicating the door cannot be opened. If an operator attempts to unlock an isolated door, a pop up warning shall display on the screen along with a voice announcement.
- 1.12 EMERGENCY RELEASE
- A. There shall be an "Emergency Evac" button located in the FCB. This button shall be placed on the screen in a location where the Operator is least likely to accidentally press it. When the operator selects this button a pop up screen shall ask the operator if they would like to continue. If the operator selects the "Yes" button (s)he will be able to emergency release doors by selecting the door icons on the display map. Opening the doors shall be a single step approach during an emergency release. The door icon shall flash red to acknowledge it has been opened. The doors shall remain unlocked until the operator cancels the emergency release function. Isolated doors shall become available to unlock in the emergency release. To relock the doors after an emergency release, the operator shall select "emergency evac" button again which will cycle the door locks to allow them to be closed/secured.
- 1.13 GROUP RELEASE

- A. Each housing area shall have a group release button. This button shall be programmed to work as a 2-step process (unlock + group release, or group release + confirmation pop up) that will open all cell doors in that housing area that are not isolated.
- 1.14 EXTERIOR DOOR
- A. All doors to the exterior of the building and the exterior of the secure perimeter shall have an additional step to unlock the door. The normal sequence of pressing the unlock button on FCB and then the door icon shall activate a pop-up box confirming that this door is an exterior door.
- 1.15 INTERLOCK OVERRIDE
- A. In the FCB, the unlock override button shall require confirmation (“yes” or “no”) in addition to the two-step unlock process to open an interlocked door.
- 1.16 INTERCOM
- A. Establishing audio communication at the VGUI with the remote intercom station shall be accomplished by either selecting the Intercom Icon on the Map Display or selecting the intercom call in the Pending Call List Display located below the site map.
 - 1. When a station or speaker is off, the icon shall be gray.
 - 2. When a station or speaker initiates a call to the VGUI control station, the icon shall flash green and be accompanied by a distinctive audible tone or voice announcement.
 - 3. When the operator selects the Intercom call the station or speaker shall turn on. When a station or speaker is on, the icon shall turn solid green and the audible tone or voice announcement associated with the call shall be off.
 - 4. A camera shall always be called up for view when a call is selected and the associated camera icon shall turn green to show its correlation to the intercom call. Intercom shall call up the nearest camera with the best view of who is standing at the intercom. Any locations without a camera with a direct view shall call up a camera that is closest to it to help show at least the general area.
- 1.17 ISOLATE INTERCOM
- A. This feature shall allow the operator to turn off an intercom station. Incoming calls will still be received and the Intercom Icon on the Display map will still flash a green color, but no voice announcement will be given and the operator will not have to answer the call. The operator shall select the Icon Isolate Icon in the FCB and then the Intercom Icon in the Map Display and the Intercom Icon in the Map Display will have a black “X” over it indicating it has been isolated. Repeating the process will reverse the Intercom Isolate.
 - B. This feature shall only be available for supervisor level users.
- 1.18 PAGE
- A. This function allows the operator to select one or more paging zones for a paging announcement. The operator will select the Page Icon in the Map Display. The Page

Icon will change to a green color during the paging operation and back to gray when the paging operation is completed.

1.19 ALL PAGE

- A. The FCB shall allow the operator to perform a paging operation in the entire facility. This function shall also include all intercom stations.

1.20 VIDEO

- A. Establish video communications at the VGUI with a VMS camera. Operator shall accomplish by selecting a Camera Icon in the Map Display.
 - 1. Upon selection of a Camera Icon the Camera Icon will turn blue and the VMS image will be displayed on the video monitor at the operator station. Camera call up shall take less than 2 seconds and shall be live video without any time delay.
 - 2. Selecting the Camera Icon again shall cancel the video and return the Camera Icon to its gray color. The video monitor shall be black.

1.21 DURESS ALARM

- A. When a duress alarm is activated the duress alarm icon on the screen shall flash red and there shall be a voice announcement alerting the operator that there is a duress alarm. If there is a camera associated with the duress alarm the camera shall be automatically displayed on the spot monitor at the operator station.

1.22 UPS ALARMS

- A. Each UPS shall provide dry contact outputs to the security system for monitoring at the VGUI station. The VGUI station shall indicate when the UPS has low battery and trouble.

1.23 EMERGENCY GENERATOR

- A. The emergency generator shall provide three dry contact outputs to the security control system for monitoring at the VGUI station. Coordinate division of responsibility of all conduit, wiring and terminations with generator provider.

1.24 PLC FAULT, LOW BATTERY

- A. Each PLC within the system shall provide dry contact outputs to the security system for monitoring at the VGUI station. The VGUI station shall indicate when the PLC has low battery and fault conditions.

1.25 ALARM OCCURRENCE LOG: Each time an alarm comes into the system, the Occurrence Log shall provide a text-based entry system required for operators to log events or notes related to the alarm before the alarm can be reset. Provide a "screen" for the Owner to customize by alarm type which alarms require a mandatory response before being reset. This list shall only be edited by admin level users in a check yes or no format.

- A. Entry of new occurrence logs

1. The operator shall enter text via the attached keyboard or option of using the software keyboard. The software keyboard shall include all standard keys including, shift, caps lock, backspace, enter, and arrow keys. As characters are selected on the keyboard they should be displayed in the appropriate field. The software keyboard shall have a CLOSE button.
 2. The operator shall select the SUBMIT button to save the entered text to the SMS. After submitted, status should indicate that the text has been sent and saved successfully, and the title and log fields should be cleared. If the text is not sent and saved successfully, the status should indicate "Log Entry Failed," and the title and log fields should not be cleared. The operator shall select the CLEAR button to clear the title and log fields.
 3. The operator shall select the VIEW LOG BOOK button to view previous entries of that specific VGUI station within the last 24 hours.
 4. The Occurrence Log entry shall be capable of 3800 characters.
- B. Viewing previous entries
1. The operator shall be capable of displaying up to 100 logged entries at the VGUI.
 2. The operator shall select the NEW LOG ENTRY button to return to the new occurrence log entry screen.
- C. All data shall be logged to SMS.
- 1.26 CARD READER ISOLATE
- A. Each card reader throughout the facility shall be able to be isolated from the VGUI station. To isolate the card reader, the operator selects the "card reader isolate" icon and within three seconds the card reader button the operator would like to isolate.
 - B. The card reader icon will have a black "X" over the reader indicating that the reader is isolated. Isolated readers cannot be used for movement through a door while the reader is isolated."
- 1.27 SECURITY MANAGEMENT SYSTEM
- A. The system shall record all of the previously mentioned operations activity to allow for automated sorting and report generation. Refer to Section 285900.

PART 2 - PRODUCTS

2.1 COMPUTERS:

- A. Video Graphical User Interface (VGUI) shall consist of PC-based workstations providing the minimum distributed processing capability as per the following.
 1. Intel Core i5-4570 quad core, 3.2GHz turbo processor or better, 512K cache, 8GB 1600MHz DD3 Memory, 250GB SSD hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM drive, sound card, video accelerator, running Windows 10 pro. Provide UPS power for all workstations.
 2. Size CPU housing in Small Form Factor or as required to fit the console/casework in which it will be located.

3. This spec shall be exceeded as necessary when multiple systems are combined onto one station.
4. Approved Manufacturers:
 - a. HP
 - b. Dell
 - c. IBM

2.2 MONITORS

- A. Provide for each Central Control VGUI operator station a 24" LCD flat panel touch screen with 1920 X 1080 pixel resolution as indicated on the Drawings.
- B. Approved Manufacturers – Dell, Samsung, NEC, HP

2.3 MONITOR ARMS

- A. Provide monitor arms for all monitors placed on casework. Arms shall be able to tilt, swivel, pan and rotate.
- B. Desktop monitor arms shall have enough range to allow the top of the monitor to be angled back greater than 45° while the bottom of the monitor is flush or within half an inch to the desktop surface. Provide all required hardware/mounting kits to permanently mount the arms to the desktop surface. Coordinate placement prior to installation.
- C. Approved Manufacturers – Egrotron, approved equal.

2.4 CONTROL STATION AUDIO COMPONENTS

- A. Provide the following audio components for each VGUI station indicated on the drawings.
 1. Desktop Microphone unit with PTT (push to talk) button to allow the user to communicate on the audio system. Microphone levels shall be adjustable from the VGUI station.
 - a. Condenser Microphone:
 - 1) Sensitivity: 1.3 mV/Pa
 - 2) Impedance: 1000Ω
 - 3) Frequency: 50-16,000 Hz
 - 4) Operation voltage: 5V via USB
 - 5) S/N ratio: More than 60dB
 - b. Provide push-to-talk push button with 6' cord, flange base with mounting holes and an audible click feedback.
 - c. Provide impedance adapter for proper audio level interface between sound card on VGUI control station PC and remote intercom amplifier.
 - d. Desktop microphone shall be Audix USB12 or approved equal.
 2. Desktop speakers to allow the user to hear communications from the audio system. Volume level shall be adjustable from both the speakers and VGUI station. Desktop speakers shall be Dell AX210 or approved equal.
 3. At SCSC's option, a desktop intercom station may be substituted for the desktop microphone and speakers at each VGUI station. Desktop intercom station shall be a vandal-resistant loudspeaker/ microphone assembly with push-to-talk (PTT) button switch and gooseneck microphone. Approved models:

- a. Available Products: Subject to compliance with requirements , provide one of the following products:
 - 1) Harding TMM-440
 - 2) Jeron 4349
 - 3) Quam DTS1
4. Provide a single gang wall-plate for mounting to a 3-1/2" deep back box. Wall-plate shall include stereo-type jacks for microphone, speaker and push-to-talk button. Wall-plate shall include RJ-45 jack for Ethernet communications between VGUI control station PC and PLC System Ethernet network.
5. Source Limitations: Obtain each type of desktop audio component from single manufacturer and provide same components for all VGUI stations.

2.5 TOUCHSCREEN OVERLAYS:

- A. Touchscreen overlays shall be of the analog capacitive technology with 1024 touch points resolution. Linearity shall be less than +/- 1% error with a drift offset of no worse than +/- .5% anywhere on the screen. Mean Time Between Failures (MTBF per MIL-HANDBOOK-217D) for the controller shall be greater than 176,000 hours and a touch life in any one location of 20 million touches. Connection from the Touchscreen to the computer shall be bi-directional asynchronous RS-232C or Universal Serial Bus (USB). The Touchscreen driver shall allow the touch area to activate upon release from the Touchscreen only. Commonly called liftoff mode.
 1. 3M Touch Systems (Microtouch)
 2. ELO

2.6 VIDEO GRAPHIC USER INTERFACE

- A. VGUI Configuration Software: The configuration software must be compatible with the PLC programming software. The VGUI stations are primarily for operator interface only. Critical control functions, such as door control, duress, and utility control are to be executed by the PLC CPU program(s).
- B. Acceptable manufacturers:
 1. Wonderware InTouch
 2. Indusoft
 3. ProVision
- C. All software shall be licensed (registered) to the Owner. Each operator station regardless of size shall be provided with an unlimited tag software package.
- D. The SCSC shall turn over to the Owner all programming passwords, source codes, backup copy on CD or USB drive of all software programs, runtime and programming licenses and programming schedules at the end of the project.

PART 3 - EXECUTION

3.1 SOFTWARE REVIEW:

- A. Refer to Section 285000 for Software Meeting Requirements.

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END OF SECTION 285020

SECTION 285030 – CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 DESCRIPTION OF WORK

- A. Provide all material and labor for all cabinets and enclosures required by the security control system for this project.
- B. Provide all connection accessories to make this a full working system. All fittings, extenders, and supplementary items shall be provided for a complete and security installation.

1.3 SUMMARY

- A. Provide cabinets and enclosures for the protection and security of the equipment contained within the cabinet or enclosure.
- B. All cabinets and enclosures shall be rated for the space within which they are installed unless noted otherwise.
 - 1. Type 1: Indoor use - protect against contact with equipment located inside and protect against dirt and dust.
 - 2. Type 3: Outdoor use – protect against windblown dust and rain, and protect against formation of ice on the enclosure
 - 3. Type 3R: Outdoor use - protect against windblown dust and rain, and protect against formation of ice on the enclosure
 - 4. Type 4: Indoor or Outdoor use – protect against falling rain, splashing water and protect against the formation of ice on the enclosure.
 - 5. Type 4X: Indoor or Outdoor use - protect against falling rain, splashing water and protect against the formation of ice on the enclosure; resists corrosion
 - 6. Type 12: Indoor use: provide protection against dust, dirt, fiber, dripping water, and condensation of non-corrosive liquids.
- C. Refer to other Div 28 sections for cabling, installation, identification and termination requirements.

1.4 SUBMITTALS

- A. Provide all product data for the cabinets and enclosures provided on this project.
- B. Provide cabinet and enclosure layouts of all security control system rooms. Provide all elevations and floor plans with dimensions indicating size of enclosures and clearances required.
- C. Provide cabinet and enclosure temperature testing results.

1.5 GUARANTEE

- A. The SCSC shall guarantee all equipment for a period of two (2) years commencing with Substantial Completion. The guarantee shall cover all costs for Warranty Services, including parts,

labor, prompt field service, pick-up and transportation. All manufacturers' warranties shall be passed onto the Owner beyond the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. Cabinet & Enclosures for Security Equipment

1. Acceptable Manufacturers
 - a. Atlas Soundolier
 - b. Eldon
 - c. Hoffman
 - d. Middle Atlantic Products, Inc.
 - e. Winsted

B. Cabinet & Enclosures for Server Equipment

1. Acceptable Manufacturers
 - a. HP (10642G2)
 - b. APC (AR3100)
 - c. Belkin (RK1000)
 - d. Dell (Startech RK4242BK0)
 - e. Chatsworth (GF-1A320)

2.2 MATERIALS

A. Cabinets

1. Cold Rolled steel units, 12 Ga angles, 14 Ga posts, 16 Ga molding and braces.
2. 16 Ga flush mount doors; flush or louvered with flush pulls
3. 16 Ga flush mount; flush or louvered, easy removal.
4. Provide door with key lock on all cabinets.
5. Provide louvers as required for cooling equipment.
6. Provide ventilation fans to maintain manufacturer recommended temperatures for equipment.
7. Provide electrical outlet and power strip for power supplies. Install wire ties around plugs to prevent the plug from being removed accidentally.
8. Floor Mounted Units
 - a. Door Control & Video Equipment Cabinets: Nominal 30" deep x 30" wide; 72-90" high; 24" EIA rack mounting frames
 - b. Intercom & Paging Equipment Cabinets: Nominal 30" deep x 24" wide' 72-90" high; 19" EIA rack mounting frames
 - c. Provide blank plates on all unused areas of the cabinet.
9. Wall Mounted Units
 - a. Provide only in room locations with size restrictions that would prevent the use of floor mounted units with proper NEC clearance from front and rear.

B. Enclosures

1. Provide wall mounted equipment as need in security control system rooms.
2. Provide hinged door with keyed lock.

3. Provide ventilation fans to maintain manufacturer recommended temperatures for equipment.

2.3 FABRICATION

- A. Install enclosures to easily accommodate interconnecting cables from above or below through the use of cable trays or conduits.
- B. Combine wires/cables by types and boards. Provide installation meeting National Electrical Code clearances, cabling installation and circuit separation requirements.
- C. Organize all wiring and cable routing by device types. Provide cabling support and tie up throughout the cabinet to provide a clean installation.
- D. No splices permitted from field device to head end connection.
- E. Provide grounding of all equipment as required by NEC.
- F. Provide protection from contact of terminals and exposed conductors.
- G. Provide din rail and mounting equipment for all applications. All equipment shall be accessible from each side of the cabinet as needed. Do not block access to required equipment to be maintained.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check location, "roughing in", and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS

- A. Provide wire management throughout cabinets and enclosures.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system.

END OF SECTION 285030

SECTION 285100 – AUDIO COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. This section includes the requirements and operational characteristics for an Audio Communication System, which is an integral part of the Security Control System. Audio Communication systems included are:
1. Remote intercom stations, ceiling-mounted speaker assemblies and speaker horns.
 2. Audio system head-end and control components utilizing Harding Instruments, MTI, or approved equal.
 3. General and Emergency Paging components.
 4. VGUI control station audio components.
- B. All components used in creating the communication system shall be of the same manufacturer and/or approved by the manufacturer for system compatibility. Equipment and specified herein is for the purpose of establishing the types of equipment and the minimum quality of equipment required. It shall be the Security Control System Contractors responsibility to assure the compatibility of all access control equipment, software, programming, cable, mounting methods, etc. that are used in providing a complete system.
- C. Provide a PLC-controlled, facility-wide, digital audio communication system, which is fully integrated with the Security Control System. This system shall provide two-way, remote reply intercommunication between VGUI control station(s) and users and remote intercom stations, speakers, and horns. This system shall allow any remote intercom station or ceiling monitoring speaker to be answered by the VGUI control station in primary control of that particular area, or by the VGUI control station(s) in Central Control.
- D. The audio system will be free from any ‘popping’, ‘cracking’ or ‘humming’ at all times. Audio annunciated at the control station shall be of sufficient quality that voice or other common sounds can be correctly interpreted at a distance of 2-4’ directly in front of the VGUI system.
- E. Each VGUI control station shall have its own dedicated talk path to all devices under its control. Sharing of talk paths between VGUI control stations will not be accepted. System shall provide for call forwarding/takeover from one VGUI control station to another after an owner specified time.
- F. The audio communication system shall interface with the VMS system via the PLC System.
- G. Each remote intercom station or ceiling monitoring speaker shall be annunciated on any VGUI control station in primary control of that intercom station or speaker’s area.
- H. Provide an audible feedback tone at each intercom station to indicate to the user that the push button has activated a call in function.
- I. The remote intercom station or ceiling monitoring speaker’s audio shall be driven through the VGUI control station computer speakers or a stand-alone intercom master station Use a desktop intercom master station at locations without VGUI control. Audio from the VGUI control

- station microphone to the remote intercom station or ceiling speaker shall only be active while the VGUI control station push-to-talk push button is depressed.
- J. Each station's volume level shall be independently software controlled. Level settings shall remain in effect until modified by a future adjustment.
 - K. The paging system shall have the capability of reaching individual areas of the facility, or the entire facility.
 - L. Paging zones shall be grouped logically, and final zone configuration shall be coordinated with the architect and owner during the submittal phase.
 - M. Intercoms shall be able to be included in paging zones.
 - N. Remote intercom stations and ceiling monitoring speakers shall be programmed to call the intercom master station that is in control of that local area. If local control is transferred or the call is not answered within a preselected number of rings or predefined length of time, the call shall be automatically forwarded to the Central VGUI control station. Calls assigned to the local intercom master stations will not show up on the Central VGUI control station until such calls are forwarded to the VGUI control station.
 - O. Acceptable Manufacturer:
 - 1. Harding Instruments – DXL Series
 - 2. MTI – digiCom Series
 - 3. Tech Works – MC-IP-Series
 - P. Provide a talk-thru communication system, which shall provide a two-way, hands-free duplex audio communications link between a partition.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Remote Intercom Station
 - 1. Intercom stations shall be designed for mounting on standard 2-gang outlet boxes. Faceplates to be constructed of 11 gauge brushed stainless. Internal steel offset grille to restrict inserting objects through speaker grille. Stations shall be ruggedly constructed and resistant to damage from soil and sprays.
 - 2. Each intercom station shall incorporate an internal loudspeaker, microphone preamplifier and multiplexing circuitry. One pushbutton shall be provided on each station.
 - 3. Pushbuttons shall be single piece stainless steel construction and shall be backstopped to prevent excessive travel. Switch shall have positive tactile action with 1 million-operation lifetime.
 - 4. Loudspeakers shall be waterproof mylar cone type.
 - 5. Provide weatherproof remote intercom station when the station is located outside. Outdoor intercom stations are to be identical in all respects to standard intercom stations except that all metal plates and hardware to be stainless steel, and internal circuitry and components to be conformal coated.
 - 6. The remote intercom station shall be a Quam model CIS4 series or approved equal.
- B. Inmate Emergency Call-In Station (Located inside Sleeping and Holding rooms)

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1. Shall be flush mounted in the wall or hollow metal frame jamb of the cell, 18" AFF as shown on drawings.
 2. Shall utilize push button call activation to the appropriate intercom master station.
 3. Inmate Emergency Call-in Station shall comply with the specifications for Remote Intercom Stations.
- C. Call Switch
1. As indicated on contract documents, provide Call Switches made of 11ga stainless steel, with vandal resistant switch that is made to mount to single gang electrical box.
 2. Call Switch shall call into the intercom call list like an intercom.
 3. The Call Switch shall be Quam CIB2 or approved equal.
- D. Drive-up Intercom/camera Pedestal
1. Provide and install intercom/camera pedestal. SCSC is responsible for coordinating all conduit, wiring, terminations, and surge protection with Division 26 to make this a working system.
 2. Unit shall be constructed per detail on Drawing SE3.1.
 3. Material shall be 12 gauge cold rolled steel, powder coated. Coordinate color during submittal phase.
 4. Unit shall be mounted per the detail on Drawing SE3.1.
- E. Drive-up Intercom Buried Detection Loop:
1. Series/Manufacturer:
 - a. EMX Industries, Inc., Cleveland, OH
 - b. Marsh Products; Batavia, IL
 - c. U. S. Traffic Corp.; Santa Fe Springs, CA
 2. Description:
 - a. Unless otherwise noted, the buried vehicle detection loop shall detect the approach of a car or van to the overhead door (or gate) and alert Central Control with a flashing icon and voice annunciation that a vehicle is waiting to enter/exit. Locations with intercom stanchion may act as an intercom call while locations without an intercom are to act as a "call-in" button. Provide a different alert tone/voice to help separate this from other call-ins. Selection of these alerts shall display the adjacent camera video. The VGUI operator shall be able to confirm the vehicle on the call-up monitor and open/close the door.
 - b. The detection loop shall not be activated by a pedestrian and/or by bicycles.
 - c. The detection loop shall utilize a magnetic field for sensing motion of ferrous metal objects.
 - d. The detection loop shall operate within the temperature range of -50 degrees to +140 degrees F.
- F. Paging Speaker Assembly
1. Ceiling and Wall mounted speaker assemblies shall consist of a Lowell 8C10W-25 speaker, a Lowell SQLK-8 baffle and a Lowell P875X back box for recessed-mount applications and Lowell CB84 back box for surface-mount applications. Exterior applications shall use assemblies rated for exterior use such as the Quam System 6VPS. Approved manufacturer; Quam, Lowell, or approved equal.
- G. Relay Selection Panel

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1. The relay selection panel shall provide individual relay control of speaker lines for paging. Provide all required PLC outputs for interface to relay selection panel(s) for a fully-functional audio communications system.
 2. The panel shall contain one control circuit per speaker line that shall provide for the selection of any line. The panel shall provide a common audio input for all speaker lines. The panel shall contain relays that operate to connect the common audio input with the appropriate speaker lines as controlled by the intercom control circuits. The panel shall contain a program bus that shall provide for program distribution to all speaker lines.
 3. The relays shall be of sealed type construction with a life expectancy of 10,000,000 operations. Relay contacts shall be rated at 2A. Less than 0.75A at 24Vdc shall be required to operate up to 25 relays simultaneously.
 4. All wire connectors to the panel shall be to insulation displacement connectors. The connectors shall accommodate 22 AWG for speaker line connections and 18 AWG for audio input connections.
- H. Paging Amplifier
1. Provide quantity required to support the number of field devices to be supported.
 2. The paging amplifier shall be mounted in a standard 19-inch rack.
 3. The paging amplifier shall be a TOA model P-906MK2 or P-912MK2 or approved equal, depending on power requirements of installed equipment.
- I. VGUI Control Station Audio Components
1. Refer to Section 285020 for Control Station Audio Components.
- J. Desktop Intercom Master Station
1. Desktop intercom master stations shall be used in locations that do not have VGUI control systems.
 2. Desktop intercom master stations to consist of display, keypads, internal speaker/microphone, telephone handset with hook switch, headset jack, and external buzzer contacts.
 3. The display module to consist of 4 line by 20-character alphanumeric LCD display mounted behind a brushed stainless steel faceplate. Display is to include a scratch and impact resistant window, adjustable viewing angle, and adjustable back lighting. Character size 0.19" H x 0.12" W.
 4. Five function keys to be provided below the display to enter menu selections. Function key action to be labeled on display and vary according to location in the menu structure and current options available.
 5. Separate 19 button keypad to include standard 12 numeric keypad keys, two scroll keys, enter key, clear key, headset key, mute key, and press-to-talk key.
 6. Key switch lifetime for all keys, 10 million operations.
 7. Telephone handset with coiled cord, press-to-talk bar, and hook switch cradle to be mounted on side of master station. Lifting handset from hook switch automatically disconnect loudspeaker/microphone communications.
 8. Desktop mounted intercom master station top housing assembly to be fabricated with single piece, brushed stainless steel, slope-faced faceplate. Rear, bottom, and side panels to be single piece formed steel with welded joints and matte black finish. Overall housing dimensions, excluding rubber feet, 9.5" W x 10.25" D x 4.5" H.
 9. Provide quantity of intercom master stations as indicated on the Drawings.
 10. Provide adequate number of intercom master ports on the master control card located in the DCC.

11. The intercom master station shall be a Harding Instruments model IMS-440-212.
- K. Talk-thru Communicator
1. The talk-thru communicator shall provide a two-way, hands-free duplex audio communications between a partition.
 2. The talk-thru communicator shall contain two voice channels, each incorporating a microphone amplifier, VOX switch, compressor, background noise monitor, attenuator controls, level detectors, and a bridge amplifier.
 3. The sound amplifier shall not exceed 0.2% THD.
 4. The talk-thru communicator shall include an operator-side gooseneck microphone, power on/off switch, power-on green LED, "talk" volume control and "listen" volume control. The exterior shall be equipped with a 2 ¼" ferrite, magnetic speaker and electret microphone. An AC adapter, which steps down 120VAC to 18VDC shall be provided.
 5. The Type 1 talk-thru communicator (TTC-1) shall incorporate a Class II bullet-resistive insert, being able to withstand a standard bullet from a .357 Magnum firearm.
 6. The SCSC shall coordinate with the partition or glass provider for the appropriate cutout size for the Type 1 unit. The Division 26 contractor shall provide local 120VAC power for each unit.
 7. Type 1 Talk-thru communicators (TTC-1) shall be equivalent to Haven Technology model #SC-100, or approved equal.
 8. Type 2 Talk-thru communicators (TTC-2) shall be equivalent to Haven Technology model #SC-300, or approved equal.
 9. Installation: Coordinate with hollow metal manufacturer, and construction document details to provide installation into the hollow metal frame section with concealed conduit for the supply of its operating power. Provide low-voltage power to the TTC from the Security Electronics equipment room.
- L. Talk-Through Intercom Unit (TTU): (Located at Visitation rooms; refer to Drawings for locations and quantities.)
1. Series/Manufacturer
 - b. TTU-5/Norcon Comm. Inc.; Inwood L.I., New York
 - c. SC-600/HAVEN Technology Corp.; Corona, CA
 2. Function
 - a. Hands-free two-way conversations.
 - b. Unit shall be bullet resistant with stainless steel faces.
 3. Components
 - a. Outside faceplate shall be approximately 13" H x 4 ½" W stainless steel with Torx-head security fasteners with center reject pin.
 - b. Back-boxes shall be 11 ½" H x 3 ½" W x 2" D.
 - c. Electronic assembly shall have as a minimum the following:
 1. Audio power: 2 watts
 2. Distortion: Less than 2%
 3. Listen Mode: 20 dB compression
 4. Talk Mode: Automatic call voice controlled (VOX)
 5. Microphones: "Electret"
 6. Power source: Line voltage in concealed wall conduit
 7. Power Supply: Input: 120 VAC, 60 Hz, Output: 15 VDC, 175 mA

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4. Installation: Coordinate with hollow metal manufacturer, and construction document details to provide installation into the hollow metal frame section with concealed conduit for the supply of its operating power. Provide low-voltage power to the TTU from the Security Electronics equipment room.
- M. Spares:
1. Refer to Section 285000.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and areas are ready to receive work.
- B. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

- A. All system equipment to be contained within equipment racks, cabinets, or closets. If more or larger equipment racks or cabinets are required than exist or are indicated on the drawings, allow for such additional equipment racks and cabinets in contract price.
- B. All system equipment equipped with plug in power connectors to be connected to a dedicated receptacle. Do not use tap connectors for plugging in multiple plugs into a single receptacle.
- C. All cable within equipment racks, cupboards, and cabinets, or on backboards, to be neatly bundled and secured. Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating.
- D. Factory manufactured interface cables to be provided for each field interface board. Terminal blocks to be provided in cabinet or on backboard for factory cable interface to field wiring.
- E. Wiring shall be executed in strict adherence to standard broadcast practices.
- F. Identify wiring by continuous insulation color. Where multi-conductor cables are used, use the same color-coding system for identification of wiring throughout.
- G. Maintain uniform phasing and color-coding throughout system.
- H. Name identification of wiring:
 1. Identify wiring at all equipment locations, pull boxes, junction boxes and outlet boxes.
 2. Develop a uniform identification scheme for use throughout the system.
 3. Record wire name identification on all applicable drawings and provide wiring tables within the operating and installation manuals.
- I. Use one of the following marking materials:
 1. Heat shrink sleeves.
 2. Clear plastic tape wrap-on strips with designated labeling section.
 3. Slip-on identification bead markers or sleeves.
- J. Replace equipment, components, and wiring as required to achieve a fully functional system.

3.3 ADJUSTING

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- A. When requested by the Architect within one year after the date of Substantial Completion, provide on-site assistance in adjusting levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions.

END OF SECTION 285100

SECTION 285200 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. The system shall consist of IP cameras, lenses, and monitors, mounting hardware, housings, network video servers, Video Data Storage Equipment, and Client workstations with software for live and recorded image viewing.
- B. The system shall permit visual monitoring and surveillance of selected areas automatically based on events via the PLC for intercom and duress stations.
- C. Provide video integration at all VGUI locations as per spec section 285020.
- D. Exterior cameras in areas of low light shall be inclusive of IR or low light capabilities to produce a clearly identifiable image when viewed.

1.3 QUALITY ASSURANCE

- A. NEC Compliance. Comply with applicable requirements pertaining to TV equipment and signal distribution systems
- B. UL Compliance. Comply with applicable requirements of UL safety standards pertaining to television equipment and accessories. Provide TV equipment and accessories, which are UL-listed and labeled.
- C. EIA Compliance. Comply with applicable requirements of Electronic Industries Associations standards pertaining to television cameras and monitors.

1.4 SYSTEM DESCRIPTION

- A. The system shall provide for the visual surveillance of all camera locations from the VGUI operator station.
- B. The system shall be integrated with the VGUI to allow events to affect the camera callup.
- C. Selected monitors shall have multiple screen display mode with selectable outputs.
- D. Controls shall allow manual selection of any camera display option.
- E. The system shall allow full frame rate (30fps) and full resolution (1080p HD) live viewing on all camera inputs and simultaneous recording at a lower frame rate and/or resolution to manage the use of storage space.
- F. Provide Power over Ethernet (PoE) for all cameras within the system.
- G. The system shall support JPEG, H.264, MJPEG, MPEG-2, MPEG-4, and be configurable on a per camera basis.
- H. Proprietary hardware or installation of video capture cards shall not be allowed.

- I. The system shall utilize TCP/IP communication protocols and reside on an Ethernet LAN physical layer.
- J. Client workstations shall be configured with dual monitor outputs to support multiple live and recorded views. Each monitor shall be capable of 16 images simultaneously.
- K. All cameras shall have vandal resistant grade housings.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION:

- A. Subject to compliance with the requirements to provide equipment from the manufacturer listed herein or an approved equivalent.

2.2 MONITORS

- A. Provide 24" HD LED Monitors that meet the following requirements:
 - 1. Digital resolution of up to 1920 x 1080 pixels.
 - 2. HDMI, DVI, and VGA inputs.
 - 3. Built-in speaker.
 - 4. Connections for video and audio input/outputs.
 - 5. On-screen display for setup and adjustment of the monitor viewing parameters.
 - 6. NTSC/PAL standards compliant.
 - 7. Equipped with base for placing the unit on a flat surface.
 - 8. Tint, color, brightness, contrast, volume, and power on/off controls.
 - 9. Black plastic cabinet with a black matte finish.
- B. Manufacturer:
 - 1. Bosch
 - 2. Hanwha
 - 3. Pelco
 - 4. Sony
 - 5. Vicon
 - 6. Approved Equal

2.3 MONITOR ARMS

- A. Provide monitor arms for all monitors being mounted on casework. Arms shall be able to tilt, swivel, pan and rotate.
- B. Desktop monitor arms shall have enough range to allow the top of the monitor to be angled back greater than 45° while the bottom of the monitor is flush or within half an inch to the desktop surface. Provide all required hardware/mounting kits to permanently mount the arms to the desktop surface. Coordinate placement prior to installation.
- C. Approved Manufacturers – Egrottron, approved equal.

2.4 INTERIOR / EXTERIOR FIXED DOME IP CAMERAS

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- A. The indoor fixed camera dome shall incorporate a fixed camera/lens combination. The camera dome shall be available for indoor surface mounting. The high-resolution day/night camera shall be available with an integral 3.3-12 mm or 9-22 mm varifocal autoiris lens. The lenses shall be available motorized to allow for remote configuration of zoom and focus (motorized focus and zoom - MFZ); it shall be zoom scalable so the iris shall automatically adjust to zoom condition. Day/night operation shall be achieved using a built-in IR-cut filter. A smoke polycarbonate lower dome that is secured by tamperproof screws shall be included. Exterior cameras shall have black housings. Interior camera housings shall be lighter in color to be coordinated during the submittal phase.
- B. The latest model available from the camera manufacturer shall be utilized.
- C. The camera position shall have a three-direction adjustment, allowing for adjustment of pan, tilt and lens rotation (roll), for any angle of view required.
- D. The camera dome shall be powered by PoE, 24 VAC or 12 VDC.
- E. The camera dome shall have dual streaming video and support H.264 and M-JPEG (2nd stream only) compression.
- F. Camera features shall include electronic iris, WDR, AGC, BLC, white balance, flip, mirror and motion detection.
- G. The camera dome shall meet the FCC requirements for a Class A device. It shall include support for the industry-standard ONVIF interface.
- H. The camera dome shall provide a slot for an SD card for local storage.
- I. Cameras shall be Color with a UL listing.
 - 1. Imaging sensor: 1/2.5" CMOS Sensor
 - 2. Lens: Varifocal 3.3 -12mm or 9 – 22mm
 - 3. For cameras indicated as wide-angle lens cameras, provide wide-angle lens ranging between 1.8 to 3 mm.
 - 4. Electronic Zoom: 2-10x (based on client software)
 - 5. Minimum illumination: Color 0.07fc, B&W 0.007fc
 - 6. Video compression: H.264 with MPEG-4 available on 2nd stream
 - 7. Casing: impact-resistant casing and polycarbonate smoked dome
 - 8. Resolution: 1080P
 - 9. Frame Rate: 2.5 – 30fps
 - 10. Power: camera: PoE (IEEE 802.3af) class 2
 - 11. Operating Temperature: with heater: (-20 – 122deg F)
 - 12. Supported protocols: HTTP, HTTPS, TCP, RTSP/RTP/RTCP, IGMP, SMTP, IPv4, IPv6, DHCP, NTP, ARP, DNS
- J. Acceptable Manufacturers
 - 1. Axis
 - 2. Avigilon
 - 3. Bosch
 - 4. Flir
 - 5. Hanwha

6. i-Pro
7. Pelco
8. Vicon
9. Or Approved Equal

2.5 EXTERIOR/INTERIOR 180°, 270°, 360° MULTI-LENS IP CAMERAS

- A. Megapixel camera with true Day/Night functionality (mechanical IR cut filter), POE and Auxiliary powered, with adjustable 2 axis camera gimbals for 360° pan and 90° tilt, privacy mask, motion detection, bit rate control and multi-streaming.
- B. The latest model available from the camera manufacturer shall be utilized. Provide mounting equipment as needed.
- C. Cameras shall be Color with a UL listing.
 1. Image Sensor: 12MP = 3MPx4
 2. Optical Format: 1/3.2"
 3. Lens: (4) F1.6, 8.0 mm, IRH-FOV: 88°
 4. Electronic Zoom
 5. Minimum illumination: Color: 0.25 lux
 6. Video compression: H.264 with MPEG-4 available on 2nd stream
 7. Outdoor rated IP66 and IK-10 impact-resistant housing and polycarbonate dome.
 8. Frame Rates: Full resolution: 5.2fps (8192 x1536), 1/4 resolution: 17fps (2048x1536)
 9. Power: camera: PoE class 3
 10. Operating Temperature: with heater: -40° F to 122° F
 11. Supported protocols: RTSP, RTP/TCP, RTP/UDP, HTTP, DHCP, TFTP.
- D. Acceptable Manufacturers:
 1. Arecont Vision AV12176DN (basis-of-design)
 2. Axis
 3. Avigilon
 4. Flir
 5. Hanwha
 6. i-Pro
 7. Pelco

2.6 EXTERIOR/INTERIOR PTZ DOME IP CAMERAS

- A. The latest model available from the camera manufacturer shall be utilized.
- B. The compact network dome shall be comprised of a camera/lens and pan/tilt drive in an enclosure.
- C. The motorized dome shall employ a modular design with an internal CPU and a customer interface board that provides connections for an external power supply input, four alarm inputs, one relay output and network wiring. On-board memory shall be retained in the housing.

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- D. The network dome shall provide network video transmission using either MPEG-4, open platform H.264 or JPEG compression. The dome shall support ONVIF open architecture connectivity to enable third party software recording.
- E. Programmable titling shall be provided for the camera and every preset position, alarm, relay, and sector. Titles shall be enabled or disabled individually or globally. The overall position of the titles and display frame position shall be programmable. The capability to fade titles after a programmable time shall be provided.
- F. There shall be eight tours available with 32 steps per tour. There shall be two auto tours available with 256 pan, tilt and zoom functions per auto tour. Timing shall be dynamic or as is actually programmed with the joystick and push buttons. During the submittal review meeting, coordinate tours with the Architect and Owner.
- G. Pan and tilt functions shall be programmable. Maximum manual pan and tilt speeds shall be programmable. Maximum pan speed shall be 400 degrees/sec and maximum tilt speed shall be 150 degrees/sec. Pan and tilt speeds shall also be scalable to the zoom setting.
- H. The camera shall provide high level, programmable functions. Configuration of the dome shall be done through a web browser. The gain control shall be adjustable. The shutter speed shall be automatic or manual. The camera shall have white balance gain using red and blue scales. Backlight compensation or Wide Dynamic Range shall be programmable. Synchronization shall be internal.
- I. The basic ceiling mounted version shall be designed to mount into any dropped or hard ceiling having the capacity to support the dome's weight. There shall be an optional mounting kit for ceilings not able to support the dome's weight.
- J. A real time clock and scheduler shall be available on all models. Up to 64 events shall be able to be scheduled for action at a programmed time of day. Events that may be scheduled include a preset, turning a relay on or off, enabling or disabling an alarm, and calling a tour or an auto tour.
- K. 16 individual zoom-scalable programmable privacy masks shall be available for simultaneous display on screen; 80 total shall be available.
- L. Motion detection capability shall be available. There shall be 12 predefined zones for motion detection. Each zone has 3 sensitivity levels. Programmable actions may be associated with each detection zone, including calling another preset, turning a relay on or off, and calling a tour or an auto tour.
- M. The dome shall have a maximum video transmission rate of 30 fps.
- N. Audio input shall be provided.
- O. Coordinate all tour programming preset positions and home position with the Owner.
- P. Cameras shall be Color with a UL listing.
 - 1. Imaging sensor: 1/2.8-inch Type CMOS sensor.
 - 2. Lens: 30X optical.
 - 3. Video compression: H.264, MPEG-4, JPEG.
 - 4. Casing: Metal casing and polycarbonate smoked dome.
 - 5. Resolution: 1080p.
 - 6. Frame Rate: up to 30/25 fps in all resolutions

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7. Power: PoE+ (indoor unit only); 18-30 VAC
8. Operating Temperature: -40-131 deg F Outdoor
9. Application: Outdoor/Impact-Resistant; IP66, Indoor Pendant; IP52, Indoor In-Ceiling; IP51
10. Image Settings: WDR, EIS, manual shutter time, compression, color brightness, sharpness, rotation, aspect ratio correction, text and image overlay, privacy mask

Q. Acceptable Manufacturers

1. Axis
2. Avigilon
3. Bosch
4. Flir
5. Hanwha
6. i-Pro
7. Pelco
8. Vicon
9. Or Approved Equal

2.7 CEILING CORNER MOUNT IP CAMERA

- A. The latest model available from the camera manufacturer shall be utilized.
- B. The indoor high-security camera shall incorporate a housing, camera, and lens. Its design shall be specifically for use in custodial suites and prison cells. The high-resolution day/night camera shall be available with an integral 2.0 mm wide angle lens.
- C. The camera shall be waterproof and shall fit into a 90° corner. It shall consist of a two part steel assembly, a fixed mounting frame and a removable front plate. The front plate shall be recessed and secured to the fixed frame with security screws. The front plate shall have a window to protect the camera. Once installed, it shall be able to be permanently sealed to the wall to make the housing ligature proof.
- D. The camera shall support proprietary H.264MP and M-JPEG compression.
- E. The camera shall have an adjustable mount that shall allow it to be tilted up or down for an exact view.
- F. The camera shall be powered by either PoE or 24 VAC.
 1. Imaging sensor: 1/2.7" CMOS
 2. Lens: 2.0mm
 3. IR Coverage: 30'; 3 LED, 940nm
 4. Video compression: H.264, MPEG-4,
 5. Casing: Vandal-resistant and anti-ligature
 6. Resolution: 1440 x 1080
 7. Power: PoE or 24VAC
 8. Operating Temperature: 14-122 deg F
- G. Acceptable Manufacturers
 1. Axis

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2. Bosch
3. Flir
4. Hanwha
5. Pelco
6. Vicon

2.8 VMS NETWORK SWITCHES:

A. Specifications:

1. 24 or 48 Ethernet 10/100/1000 PoE+ ports with minimum of 1 Gigabit uplink
2. 370-740 W of available PoE power.
3. 4 - Gigabit Ethernet SFP ports for stacking or uplinks
4. Ability to stack units or implemented as a distributed stack at multiple locations and managed as a single-IP entity
5. Multicast routing, IEEE 802.3af Power over Ethernet
6. High resiliency and continuous availability with active load sharing and support for ultra-fast failover recovery
7. Layer 2 security with ACL ports, IEEE 802.1X operation with multiple authentication mechanisms.
8. Have the ability to prioritize converged network traffic to ensure high levels of service for latency-sensitive applications

B. Acceptable Manufacturer

1. Cisco
2. HP
3. Approved equal

2.9 LENSES

- A. This contractor shall include in their estimate lenses adequate for the functional criteria described and shall change lenses without additional cost to the Owner such that all areas are appropriately covered under actual test conditions. Cameras monitoring specific doors shall have lenses adequate to identify the individual.
- B. Cameras monitoring outdoor activity, long corridors, and large indoor areas shall have lenses adequate to identify the nature of the activity in the area.
- C. During the final testing of the system, the Owner shall sign off on each camera view for proper angling and coverage. This signed list shall be submitted before substantial completion.

2.10 CAMERA HOUSINGS AND SUPPORTS

- A. Recessed ceiling or wall mounted housing shall be a high security camera enclosure rated for interior or exterior use with a built in heater. For exterior wall mounted applications provide appropriate mounting arms and brackets.
- B. Provide all accessories to accomplish the specified mount according to the camera schedule. The mounts shall all have internal protective passage for cables. All cameras and domes shall be mounted with required housings for complete installation.

2.11 POWER SUPPLIES

A. INTERIOR 24 VAC POWER SUPPLY

1. Input Voltage: 120VAC, 60 Hz
2. Output Voltage: 28VAC, Fusing: 10A
3. Input Connector: Line Cord
4. Output Connector: Screw type barrier strip
5. Rating: NEMA1
6. 32 class 2 rated PTC protected power limited outputs

B. Acceptable Manufacturer:

1. Altronix
2. Approved Equal

END OF SECTION 285200

SECTION 285220 – INTERVIEW ROOM RECORDING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. This section includes the requirements and operational characteristics for an Interview Room Recording System (IRRS) for the discrete recording of audio and video through camera(s) and microphone(s) within the designated interview rooms.
- B. The interview room recording system shall be an independent system, with no audio or video connections to the main Security Control System.
- C. Interview recording equipment and viewing workstation shall be in Office 164. Workstation shall provide access to monitoring of both live and recorded video from all Interview rooms.
- D. Provide all labor, equipment, materials, and supervision to install, program, calibrate, adjust, document, and test the total system as required herein and on the drawings.

1.3 SYSTEM DESCRIPTION

- A. The system shall accommodate at least three (3) interview rooms, and be composed of the following components, as a minimum:
1. IRRS Workstation/Server with RAID 1+0 mirrored hard drives.
 2. Applications Software for recording, viewing, archiving, annotating, and exporting audio/video interview recordings.
 3. Two (2) IP high definition cameras per room.
 4. One (1) high quality digital microphone per room.
 5. Control and initiation through a standard wall mounted light switch or other approved method, with the ability to initiate and stop recording through the IRRS workstation.
 6. Ceiling or wall mounted light shall be provided outside each interview room to indicate when that room is actively being recorded.

1.4 SYSTEM FEATURES AND SOFTWARE REQUIREMENTS

- A. System Features:
1. Real-time audio and video display for concurrent monitoring.
 2. Synchronized audio and video recording and playback.
 3. Separate audio channel saved from audio/video recording for easy and secure transcription.
 4. Recording multiple interview rooms on a single computer.
 5. Configurable case information annotation for consistent documentation of case specifics.
 6. Support for recording/displaying multiple video (not picture-in-picture) feeds for the same or different interviews.

7. Ability to export to standard file and media formats.
8. Custom watermark plus time and date stamp imbedded onto every frame.
9. Automatic gain control and noised reduction facilities for clear audio playback.
10. Configurable frame rates and resolutions, up to 30 images per second at 720P for each camera.
11. IP camera support.
12. MAC, iPad, and Android playback programs.
13. Export of user defined sessions to DVD.
14. Non-proprietary hardware.
15. Digital signatures for authentication.

PART 2 - PRODUCTS

2.1 IRRS Workstation

1. The PC-based workstation with licensed application software, shall (at a minimum), consist of an Intel Core i5-4570 quad core, 3.2GHz turbo processor with 512K cache, 8GB 1600MHz DD3 Memory, RAID 1 with two (2) each 2.0TB hard drives, 2 USB ports, network card for Ethernet operation, video/audio inputs for IP cameras and microphones, CD-ROM drive, Dual double layer DVD writer, sound card, video accelerator, wireless headphones, running Windows 8 pro. Provide UPS power for workstation.
2. One (1) 22" high resolution, 1080P displays.
3. Approved Manufacturers:
 - a. HP
 - b. Dell
 - c. Microsoft

2.2 Cameras

1. Corner or Recess Mount
2. Resolution: 1280 x 720.
3. Frame Rate: 30fps.
4. Compression: H.264, MJPEG.
5. Lens: 2.8mm.
6. Coordinate placement with Owner.
7. Approved Manufacturers:
 - a. Bosch
 - b. Axis
 - c. Flir
 - d. Sony
 - e. Hanwha

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- 2.3 Microphones:
1. Studio grade quality.
 2. Omni-directional, condenser.
 3. Mount to single gang electrical box.
 4. Approved Manufacturers:
 - a. Louroe
 - b. AKG
 - c. AXIS
 - d. Sony

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Check location, "roughing in", and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as shown on Drawings and as instructed by manufacturer
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS:

- A. Replace equipment, components, & wiring as required to achieve a fully functional system

END OF SECTION 285220

SECTION 285260 – VIDEO MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 WORK IN THIS SECTION:

- A. A Video Management System (VMS) shall be provided to support all of the cameras in the facility.
- B. This section includes the requirements and operational characteristics for a Video Management System, which is an integral part of the Security Control System. Video Management Systems included are:
 - 1. Video Management System Servers
 - 2. Video Storage equipment.
 - 3. Client Computers.
- C. Provide all labor, equipment, materials, licenses, and supervision to install, program, calibrate, adjust, document, and test the total system as required herein and on the drawings.
- D. Provide documentation, as part of the submittal, indicating that the individuals installing the Video Management system have been trained and have installed this product prior to this project.

1.3 SYSTEM DESCRIPTION

- A. Provide a Video Management System with the following system features and software requirements to allow for seamless control and future flexibility:
 - 1. Integration of the VMS with the VGUI system to allow VGUI operators to provide manual camera call-up, automatic camera call-up (from active intercom call, duress alarm, etc.) and display of live video in a designated area on the VGUI monitors.
 - 2. Digital video recording of all the cameras in the VMS system.
 - 3. Configuration, viewing of recorded images, and ability to record incidents to DVD-R discs.
 - 4. Video recording should be in a non-proprietary format such that no special program is required to view them.
 - 5. Provision of client computers loaded with the VMS client software to perform the following operations;
 - a. Live display of cameras
 - b. Live display of camera sequences
 - c. Control of PTZ cameras
 - d. Playback of archived video
 - e. Retrieval of archived video
 - f. Instant replay of live video
 - g. Use of procedures
 - h. Configuration of system settings
 - i. Execution of system macros

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- B. VGUI station shall have ability to call up camera views to a secondary monitor attached to the VGUI station. Camera selection for each VGUI shall be limited to that VGUI's control responsibilities (i.e. – the Pod VGUI station shall only be able to select cameras that are in its area of control).
- C. The VMS software run on standard off-the-shelf computer server and communicating over Ethernet network using the TCP/IP network protocol. The proposed solution shall not require proprietary computer hardware. The proposed solution shall be based on Windows™ Server Operating System.
- D. The VMS system shall be based on the latest in software programming technology and shall be based on Microsoft .NET frame work. The software shall be the latest and most current platform offered by the manufacturer.
- E. The VMS system shall support both analog and IP cameras. Support of analog cameras shall be done using Camera Encoder Video Servers and shall not require the installation of video capture cards.
 - 1. The VMS shall support both NTSC and PAL video formats.
 - 2. The VMS shall support video both from analog and IP fixed color/B&W cameras, PTZ/Dome cameras, infrared cameras, X-Ray cameras, low light/IR cameras, and any other camera that provides a composite NTSC/PAL 1v p-p video signal.
- F. The VMS shall support the H.264, JPEG, M-JPEG, MPEG-4, MPEG-2 video format simultaneously.
- G. The VMS shall sustain full operation using VGA, HD and Megapixel video resolutions.
 - 1. The VMS shall be able to support all cameras at the maximum frame rate and the maximum resolution while maintaining less than 80% load on the Server.
- H. The VMS in addition to Video shall provide full Audio monitoring and recording functionality.
- I. The VMS shall allow for 2-way audio communication using the audio interface
 - 1. The VMS shall provide the ability to communicate back to an audio enabled Encoder, Decoder or IP camera and provide an IP based Intercom.
- J. The VMS Audio function shall be available as independent sources and/or synchronized with video.
- K. The VMS shall allow the use of audio inputs for Audio recording of telephone lines, microphones, radio systems or any other analog audio interface.
 - 1. The VMS shall allow for audio search by date, time and alarm event with or without association to video.
 - 2. The VMS Media Archive Server, for video and audio, shall be sized to support and manage all camera connection from IP cameras or video Encoders each at 30fps.
- L. The VMS shall be based on the TCP/IP communication protocol between all IP cameras, Encoders, Decoders, Video Management Management Software and Media Archive Servers.
- M. The VMS storage system shall be based on advanced recording methods and shall not rely on the Windows Operating System to manage the storage.
- N. The VMS shall provide the coactivity to an external storage system. The VMS storage option as a minimum shall provide RAID-5 redundancy. All storage redundancy and mirroring

capabilities shall be done using hardware interface and shall not rely on the Windows Operating System to perform these functions.

- O. The VMS shall be based on high quality H.264 and/or MPEG-4 IP cameras.
- P. The network based video recorder server (Media Archive Server) shall as a minimum provide multi-video compression support and shall simultaneously record video from H.264, MPEG-2, MPEG-4 video and JPEG and M-JPEG image compression algorithm standards. The VMS shall allow for specific camera to be set at the most optimized recording technique, H.264, MPEG-2, MPEG-4, J-PEG or M-JPEG, and should be available for live monitoring and recording signals. The system shall be flexible and as a minimum, the compression scheme shall be able to run in one of several bandwidth selections.
- Q. The system shall allow the recording, live monitoring, playback of archived video audio, and data simultaneously. The VMS shall allow the user to view live video at 30 fps while recording at a lower frame rate for more efficient video storage.
- R. The VMS client application shall support two flat panel monitors to be connected to a single computer.
- S. Each monitor shall have independent controls and shall support multi views up to 16 real time camera views.
- T. The VMS client application shall allow each user the ability to view 32 cameras on a single PC, all at 30fps.
 - 1. The system shall maintain the capability to add additional flat panel monitors for other applications.
- U. The VMS shall provide a reporting utility for tracking, including, but not limited to, the following options. Video and images shall be stored with reports for documenting events.
 - 1. Alarms
 - 2. Incidents
 - 3. Operator logs
 - 4. Service requests
- V. The IP Based VMS shall provide a file export tool for export of single frames of video in J-PEG and BMP file formats and for export of motion video files in AVI file format for transport and playback on computers utilizing a Windows environment.
- W. The VMS database and video storage shall be based on SQL Server. The VMS operating system shall be Microsoft Windows Server. The IP Based VMS shall allow for installation of Anti-Virus and network security Software. This shall be on a separate network.
- X. The VMS shall be initially configured by the Security Control System Contractor, and coordinated with the Owner, to configure system parameters according to the operation of the facility, taking the needs of all cameras (down to an individual basis) into consideration.
- Y. Acceptable Manufacturers:
 - 1. Avigilon
 - 2. Bosch
 - 3. Exacq
 - 4. Genetec
 - 5. Hanwha

6. Milestone
7. Pelco
8. Vicon
9. Video Insight
10. Or Approved Equal

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Video Management System (VMS) Central Directory Server

1. General: The Directory Server shall store a centralized system database and manage the VMS and user security privileges.
2. VMS Server Software:
 - a. The VMS software shall consist of an MS-SQL 2008 or better based Main Directory Database Server, Media Archive Server (audio and video), Digital Virtual Matrix, Incident Reports, Alarm Management, Network Management System and Watchdog modules.
 - b. The VMS SQL based Database Server shall offer the capability to be installed on multiple servers to enable distributed architecture on the LAN or WAN.
 - c. The VMS Database Servers shall not limit the number of Media Archive Servers which can be networked together to form a distributed video management and recording system.
 - d. The VMS Database Server shall maintain a catalog of settings for all the client, servers, encoders, decoders and IP cameras in the system.
 - e. The VMS Media Archive Server shall offer the capability to be installed multiple servers software on multiple Computer Servers to enable distributed archiving architecture on the LAN or WAN.
 - f. The VMS shall record all video from all IP cameras, in the native video format of each (e.g. Mpeg-4, MPEG-2 or M-Jpeg video compressions).
 - g. The VMS shall record all video in real time simultaneously at bandwidth ranging from 8 Kb/sec to 4 Mb/sec, frame rates ranging from 1fps to 30fps NTSC/25PAL and resolution ranging from CIF (352X240 NTSC) to 1080p HD (1920x1080 NTSC).
 - h. The VMS shall be able to set each camera frame rate, bit rate and resolution independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
 - i. The VMS shall require no proprietary hardware for video and audio recording servers.
 - j. The VMS shall not utilize any hardware or software multiplexer or time-division technology for video or audio recording and monitoring.
 - k. The VMS shall provide a Redundant recording module for system redundancy.
 - l. The VMS shall support a built-in Digital Video Matrix Switcher
 - m. The VMS shall support an Internet Video Broadcast server (IVB).
 - n. The VMS shall support video motion detection module.
 - o. The VMS shall support a built-in Watchdog module.

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- p. The VMS shall provide a full interconnectivity between analog matrix operations and IP video to analog and digital outputs. The VMS shall have the capacity for unlimited analog video inputs and outputs.
 - q. The VMS shall have the capability to program each IP viewing station to view and control selected cameras only.
 - r. The VMS shall provide a Windows-based GUI (Graphical User Interface). The VMS shall provide operation on multiple VGA monitors connected to a single PC using standard hardware and software.
 - s. The VMS shall be based on a true open architecture that allow for use of industry standard PC and storage hardware that shall not limit the storage capacity and shall allow for gradual upgrades of recording capacity. The VMS shall digitally sign recorded video using 2048-bit RSA public/private key encryption. The VMS shall allow for changing the encryption key.
 - t. The VMS Shall support management and control over unlimited satellite sites.
 - u. The VMS shall provide alarm dry contact interfaces to allow for any alarm input initiating any action in the VMS system. The VMS shall provide a serial interface for alarm input to allow for any alarm input initiating any action in the VMS system.
 - v. The VMS Shall support full duplex audio communication and transmission signals over the IP Digital Transmission Network.
 - w. The VMS shall provide alarm management module.
3. VMS Central Directory Server Configuration (minimum requirements):
- a. Dual Processor (x2) Intel Xeon ES-2660, 2.20GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 95W, Max Mem 1600MHz
 - b. Memory: 32GB: Two (2) 16GB RDIMM, 1600MT/s Low Volt, Dual Rank, x4 Data Width
 - c. Operating System: Windows Server 2016
 - d. Hard Drive Configuration: RAID 1, with discrete RAID Adapter with Battery Backup and 512MB NV Cache.
 - e. Hard Drives: Two (2) 250GB Solid State, SAS, SLC 6Gbps, 2.5", hot-pluggable
 - f. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
 - g. Network Adapter: On-Board Dual Port Gigabit Network Adapter
 - h. DVD 8X Optical Drive
 - i. 5 Years of Manufacturer Hardware Warranty with Critical Support Services (24x7x365 with 2-hour onsite response)
 - j. Approved manufacturers: Dell PowerEdge series, HP
- B. Video Management System (VMS) Archiver Server
- 1. General: The Archiver Server shall operate the recording and playback of video, audio and meta-data. Provide required number of archiver servers to meet system requirements.
 - 2. VMS Archiver Server Configuration (minimum requirements):
 - a. Dual Processor (x2) Intel Xeon ES-2660 2.20GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 95W, Max Mem 1600MHz
 - b. Memory: 32GB: Two (2) 16GB RDIMM, 1600MT/s Low Volt, Dual Rank, x4 Data Width
 - c. Operating System: Windows Server 2016

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- d. Hard Drive Configuration: RAID 1, with discrete RAID Adapter with Battery Backup and 512MB NV Cache.
- e. Hard Drives: Two (2) 250GB Solid State, SAS, SLC 6Gbps, 2.5", hot-pluggable
- f. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
- g. Network Adapter: On-Board Dual Port Gigabit Network Adapter
- h. DVD 8X Optical Drive
- i. 5 Years of Manufacturer Hardware Warranty with Critical Support Services (24x7x365 with 2-hour onsite response)
- j. Approved manufacturers: Dell PowerEdge series, HP

C. Video Storage Equipment

- 1. General: Direct attached disk storage enclosures shall be provided supporting multiple SAS drives for the storage of video files. The storage enclosures shall be attached to the VMS server(s) and shall be configured in a RAID 5 configuration. Sufficient disk storage shall be provided to provide video storage for all the cameras in the VMS system with the following configuration: All cameras being recorded continuously 24/7 at 7.5 images per second per camera without motion and at 15 ips on motion, recording at native resolution, with H.264 and/or MPEG-4 compression, assuming an activity level of 35% across all cameras and providing for a minimum of 30 days of storage. The system automatically replaces the oldest video stored when the system storage capacity is reached.
- 2. Provide multiple attached disk storage enclosures (as required for recording requirements) which meet the following specifications;
 - a. PCI SAS RAID adapter for the VMS Archiver Server, for RAID 5
 - b. Hot-pluggable SAS Drives (size and type based on calculated storage required)
 - c. Storage Enclosure shall be configured for N+1 drives to ensure there is a hot, spare drive available
 - d. Hard drive capacity: Up to twelve (12) hot-pluggable SAS Hard Disk Drives (HDDs) at 7200, 10K, and 15K rpm and SAS solid state
 - e. Maximum capacity per enclosure: 48TB using twelve (12) 4TB 7,200 RPM 6Gb/s SAS drives
 - f. Two (2) enclosure management modules
 - g. Power Supply: Redundant Power Supplies with separate power cables to connect to different circuits.
 - h. Approved manufacturer: Dell™ PowerVault™ MD1200 series with sufficient storage to meet the requirements as specified above.

D. Client Computers

- 1. General: VMS Client Computers shall be provided at locations as shown on the plans. Designated client computers shall provide the administrative user interface for the system, enabling the definition and configuration of various system aspects.
- 2. VMS Client Software
 - a. The VMS client shall consist of Administrator Tool application, a Monitoring application, an Archive Player application, a Web Monitoring access, a Web Archive Player access and a Mobile Monitor application.
 - b. The VMS client shall perform the following applications simultaneously without interfering with any of the Archive Server operations (Recording, Alarms, etc.): live display of cameras, live display of camera sequences, control of PTZ cameras, playback of archived video, retrieval of archived video, instant replay of live

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- video, use of procedures (Macros), configuration of system settings, execution of system macros.
- c. The VMS client applications shall support any form of IP network connectivity, including: LAN, WAN, VPN, Internet, and Wireless (WiFi and Cellular) technologies.
 - d. The VMS client applications shall support IP Multicast (UDP) and Unicast (TCP or UDP) video streaming. The VMS client applications shall automatically adapt to the network topology and use the best available method to receive streaming video.
 - e. The VMS client applications shall provide an authentication mechanism, which verifies the validity of the user.
 - f. The Client Monitor application shall allow for live monitoring of video and audio.
 - g. The VMS Monitor application shall allow operators to view an instant replay of any camera.
 - h. The VMS Monitor application shall allow operators to add bookmarks or to switch their instant replay view into the Archive Player application, for advanced operations, by clicking on a single button in the Instant Replay tab.
 - i. The VMS Monitor application shall provide management and control over the system using a standard PC mouse, keyboard and VMS keyboard.
 - j. The VMS Monitor application shall display all cameras attached to the system regardless of their physical location on the network.
 - k. The VMS Monitor application shall display all camera sequences created in the system. The VMS Monitor application shall allow for unlimited cameras sequences, which can be run independently of each other on either digital VGA monitor tiles or analog VMS monitors.
 - l. The VMS Monitor application shall allow operators to control (Pause/Play, skip forwards, skip backwards) Camera Sequences, without affecting other operators' ability to view and control the same sequence.
 - m. The VMS Monitor application shall display all cameras, sequences and analog monitors in a logical tree. The VMS Monitor application operator shall be able to drag and drop a camera from a tree of available cameras into any video tile or an analog monitor icon for live viewing. The VMS Monitor application operator shall be able to drag and drop a camera sequence from a tree of cameras into any video tile or an analog monitor icon for live viewing.
 - n. The VMS Monitor application shall support the procedure functionality, where procedures can be triggered to appear during a certain event & can be used to provide detail written or verbal instructions to the operator as to the actions to be taken.
 - o. The VMS Monitor application shall support digital zoom on a fixed camera's live video streams. The VMS Monitor application shall support digital zoom on a PTZ camera's live video streams.
 - p. Each workstation running the IP Based VMS client application shall be able to use a VMS keyboard that can control the entire set of cameras throughout the system, even if the system consists of motorized cameras produced by different manufacturers.
 - q. The VMS shall support full control for PTZ (Pan Tilt and Zoom) cameras.
3. Client Workstation with keyboard & mouse shall consist of an Intel Core i5-4570 quad core, 3.2GHz turbo processor or better Computer with 512K cache, 8GB 1600MHz DD3 Memory, 250GB hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM

drive, sound card, video accelerator, running Windows 10 Pro. Provide UPS power for all workstations.

4. Approved manufacturers:
 - a. Dell
 - b. HP
5. Approved client software manufacturer:
 - a. Avigilon
 - b. Bosch
 - c. Exacq
 - d. Genetec
 - e. Hanwha
 - f. Milestone
 - g. Pelco
 - h. Vicon
 - i. Video Insight
 - j. Or Approved Equal

E. Accessories:

1. Provide one or more KVM switches sized for the number of Video Management System servers in the system. Approved KVM switches: Tripp Lite. Provide KVM Switch cable kits as required.
2. Provide 1U Rack Mount LCD monitor keyboard drawer with 19" TFT, keyboard and touch pad equal to Acnodes Model KD8190 or approved equal.
3. Provide multiple 24-port 10/100/1000 BASE-TX Fast Ethernet managed stackable rack-mountable switches with 2 mini GBIC ports.

F. Spares:

1. Refer to Section 285000.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

- A. The Security Control System Contractor shall provide a block-switching table that incorporates all requirements of the intercom, video call up and alarming specified in all other sections of this division. The Owner shall maintain the right to request modifications at any time during the warranty period at no charge.

3.2 EXAMINATION

- A. Verify that surfaces and areas are ready to receive work. Verify field measurements are as shown on Drawings and as instructed by manufacturer. Verify that required utilities are available, in proper location, and ready for use.

3.3 INSTALLATION

- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, and wiring as required, achieving a fully functional system.

3.4 COMMISSIONING

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- A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, programming, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner through the Architect, with at least seven days notice.

END OF SECTION 285260

SECTION 285300 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. Provide and install as shown on the Drawings and herein specified a complete and operable Access Control System. Readers shall consist of proximity readers, proximity reader/keypads, and other access control system devices. Upon correctly entering a personal ID code or presenting a proximity card / keyfob to the system shall grant access to a controlled device or resource
- B. System shall be independent of any existing card access systems. Coordinate with the owner all the card, keyfob or other credential types being used by the owner and provide a system that will work with those existing credentials.
- C. The Access Control System shall be installed in accordance with all applicable NEC, and local building codes. All equipment shall be UL labeled. All equipment shall be compatible
- D. The Access Control System shall interface to the Fire Alarm System as required to meet all required Fire and Life Safety Codes
- E. The system shall include, but not be limited to, the following
1. Proximity card readers
 2. Proximity card & keypad combo readers
 3. Control Processors
 4. Alarm monitoring modules
 5. Output relay modules
 6. Access control proximity cards & key fobs
 7. PC running the Card Access System's Software
 8. All required licenses to function completely and expand 25%.
 9. I.D. Photo Access Cards with identification images and logos
 10. Support Biometric readers
 11. Support Magnetic stripe card readers
 12. Support keypads & pin pads
- F. Provide archive/purge and backup utilities for database maintenance.
- G. The Access Control System's database shall be fully integrated with the database of the Security Management Server (SMS), allowing the token user's Name, not ID code, to be logged by the SMS upon any use of a token reader. The system shall log all access control events, including access granted, access denied, and duress codes used. All access control events shall be associated with the token user's Name. Provide secure lock operation and maintain audit trail, even when the server or the network is unavailable.

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- H. The Access Control System's database shall be capable of a minimum of 5,000 user accounts. The Access Control System shall be capable of supporting 100 client licenses. Access Control system database shall be Microsoft SQL 2008 or better.
 - I. The Access Control System shall be a robust, user-friendly, easily expandable solution. Users shall be added, modified, and deactivated using a Windows-based GUI interface. Each user shall be given customized access rights to controlled devices and other resources based on the time of day, day of the week, and restricted dates. In addition, users must be able to be assigned to customized user groups, which system administrators shall be able to create in order to streamline the access management process and tailor it to their own needs.
 - J. The Access Control System shall integrate seamlessly with the Security Control System to visually alert operators when a door has been accessed via the reader system and shall allow VGUI operators to isolate (disable) individual readers to prevent access. The SMS shall be able to log requests at doors with an isolated reader. Users shall be capable of entering Duress Codes at proximity reader/keypads, which shall activate a duress alarm at that location on one or more VGUI's. The same level of integration shall also be seen on the SMS, which shall record the user's Name and time when a resource is accessed and shall include a full range of reporting features. Login to the Access Control software shall be password protected and access shall be logged to the SMS.
 - K. The access system shall not directly open any doors. It shall make door open requests of the PLC System. The PLC System shall verify interlocking of the requested door and status of the reader prior to any unlocking.
 - L. The system shall also have a fully integrated, Windows-based help system. The system shall also have context sensitive help.
 - M. The system shall have a lockout feature after an invalid access code has been entered four times on a keypad.
 - N. The system shall be programmable with a master code so that access can be granted through a card reader/keypad combo device with only the master keypad code and no proximity card.
 - O. Provide hardware and software as a single integrated application for all of the following:
 - 1. Online locks that are programmed and controlled via a central computer which communicates via the network to controllers which are then wired to the individual door locations.
 - 2. Offline locks which may become disconnected from a central computer system, but are managed and programmed by the same software application.
- 1.3 CARD ACCESS CLIENT VIEWING STATION COMPUTER:
- A. Central Equipment: Provide a Client station with Card Enrollment equipment as indicated on the drawings. All central equipment power shall be provided from emergency circuits. Additional UPS or Battery Backup power shall be provided for all central equipment to provide error free operation. Central equipment shall include but not be limited to the following:
 - 1. Intelligent Controller: Supports up minimum of 8 readers. Firmware for 10,000 cardholder records and 1,000 transactions. Shall support both proximity readers and keypads simultaneously for each door. Systems shall be capable of optionally supporting LAN or WAN communications using TCP/IP.

2. Access Control Software shall operate on Windows 10 or better. Software shall include Administration, Event Monitoring, Status Windows, and multiple application windows open simultaneously, Software shall also include the following.

1.4 SOFTWARE FEATURES

- A. User Configuration Functions: A user shall include any individual that uses the access control system to access resources, such as a door, software application, or VGUI. A user shall also include an administrator who is using the access client software to add users and set permissions and rules. User configuration functions shall include the following:
 1. Creating a New User
 - a. Provide a User Configuration screen that shall allow the operator to create a new user or display information about current users. The information fields displayed shall include the following; Last Name, First Name, Middle Name and ID Number. The ID Number shall be any combination of letters and numbers up to a maximum of 50 characters
 - b. Optionally, a User Type shall be capable of being selected: Types shall include (None), Staff, and Visitor. A user type of Inmate or Staff must be selected when using the work release or time and attendance tracking features respectively
 - c. Any custom user information shall be capable of being entered into the Additional Information tab
 - d. An image shall be capable of being associated with a user and stored in the SMS database for retrieval from the client software or VGUI(s)
 2. Modifying a User (Searching)
 - a. Provide a means to modify information about existing users
 - b. Provide a User Search dialog box that, by default, displays all active users in the database. The User Configuration screen for each user shall be displayed upon the selection of a user in the database
 - c. Provide a means to facilitate a more refined search. The operator shall be capable of selecting a field (i.e. – Last Name, First Name, ID Number, token, etc.) to search on in a “Search” list and typing the desired text in a “For” box. The operator shall also be capable of searching for deactivated accounts by means of a checkbox selection
 3. Acquiring an Image for a User
 - a. Provide a means to capture an image and associate it with an individual user in the database
 - b. Provide an Image Acquire screen that shall allow an operator to capture an image via an image capture device (i.e. – USB camera). Provide a drop-down list of available image capture devices
 - c. Provide a preview window that displays a live video stream. Depending upon the options available for the selected image capture device, provide Format, Source, Compression, and Display buttons to allow the operator to fine-tune the video stream
 - d. Provide an Image Capture button for the operator to select once the user is positioned properly in the preview window. Once selected, the image shall appear in a separate user image window. Provide a means to assign the captured image to the user
 4. Importing an Image for a User

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- a. Provide a means to import an image and associate it with an individual user in the database
 - b. Provide an Import Image screen that shall allow an operator to import an existing image. Provide a window for the operator to browse to an existing image and open the image once it is found
 - c. Provide an outlined area (or box) showing the size of the user image window. If the imported image is larger than the user image window, the operator shall be able to relocate the image box by holding down the left mouse button and dragging the box to the desired location within the image. Provide a means to assign the imported image to the user
5. Assigning Permissions to a User
- a. Provide a means to allow users access to system resources
 - b. Provide an Assign Permissions tab within the User Configuration screen. This screen shall show a list of all system resources. Each resource shall include a checkbox to allow access to that particular resource. Provide a "filter" box with drop down menu to allow the operator to select and display a particular type of resource. Resource types shall include, but not be limited to, the following; Doors, VGUI's, Access Control System Client software, SMS client, etc
 - c. Provide Check All and Uncheck All buttons for the operator to select to simplify the assignment of permissions
6. Assigning a User to User Groups
- a. Provide a means to allow users to be assigned to User Groups. A User Group shall be defined as a specific group of users who share the same permissions and rules. When a user is assigned to a group, they shall receive the same permissions and rules that the group has, in addition to their own individual permissions and rules. Users shall be capable of belonging to more than one user group
 - b. Provide an Assign Groups tab within the User Configuration screen. This screen shall show a list of all user groups in the system. Each group shall include a checkbox to assign the user to that particular group
7. Assigning Rules to a User
- a. Provide a means to assign rules to a user. Assigning rules to a user shall allow the user's permissions to be restricted to specific days of the week, as well as specific times of the day. Provide a means to have a user's access to activate or expire on a specific day or prevent them from using permissions on restricted dates
 - b. Provide an Assign Rules tab within the User Configuration screen. Provide an 'Allow access only on selected days of the week' checkbox for users that are allowed access only on specific day(s). Provide checkboxes for each day of the week for the operator to select for days they want the user to have access on
 - c. Provide an 'Allow access only during time range' checkbox for users that are allowed access only during specific times. Provide time configuration boxes for 'No earlier than' and 'No later than' that include the time in hours, minutes and seconds. Provide indications for "AM" and "PM"
 - d. Provide an 'Unrestricted Access' checkbox to select for users that have no access restrictions based on the time of the day and the day of the week
 - e. Provide an 'Access has activation date' checkbox for users that have permissions that should not begin until a later date. Provide a drop-down calendar tool to set the activation date

- f. Provide an 'Access has expiration date' checkbox for users that have permissions that should expire on a certain date. Provide a drop-down calendar tool to set the expiration date
 - g. Provide an 'Allow access on restricted dates' checkbox for users that are allowed access on restricted dates
8. Assigning Tokens to a User
- a. Provide a means to assign tokens to a user. Assigning Tokens to a user consists of assigning items such as a PIN code, Duress Code, proximity card number, password, etc. that the Access Control System uses to identify a user
 - b. Provide an Assign Tokens tab within the User Configuration screen. All tokens assigned to a particular user shall be displayed on this tab
 - c. Provide information fields for the following tokens: Proximity Card, Personal Identification Number, Duress Code and User Name and Password
 - d. Provide a Proximity Card field that shall be used to assign a proximity card or keyfob ID number to the user. For this feature, a proximity reader enrollment station may be used. The operator shall activate an Enroll button and swipe a proximity card or keyfob at the enrollment reader. The proximity ID will appear in the field when the card or keyfob is read
 - e. Provide a Personal Identification Number field that shall be used to assign a unique number to a user for use with proximity readers with a keypad option. Upon correct entry of a personal identification number at a keypad, the user shall be granted access to the resource. The personal identification number shall be up to a maximum of 12 digits long, and unique for all users
 - f. Provide a Duress Code field that shall be used to assign a unique number to a user for use with proximity readers with a keypad option. Upon correct entry of a duress code at a keypad, the local and Central Control VGUI(s) shall be notified that a duress alarm exists. The duress code shall be a maximum of 13 digits long
 - g. Provide User Name and Password fields that shall be used to assign a unique user name and corresponding password for the purpose of accessing VGUI's and the access control system client software
 - h. Provide for a replacement card to automatically invalidate the user's previous lost card
9. Creating a New User Group
- a. Provide a means to create User Groups, which shall allow the operator to easily assign the same permissions and rules to many users
 - b. Provide a Group Configuration screen that shall allow the operator to create a new group or display information about current groups. The information fields displayed shall include the following; Group Name
10. Modifying a User Group (Searching)
- a. Provide a means to modify information about existing user groups
 - b. Provide a User Group Search dialog box that, by default, displays all active user groups in the database. The User Group Configuration screen for each user group shall be displayed upon the selection of a user group in the database
 - c. Provide a means to facilitate a more refined search. The operator shall be capable of selecting a field (i.e. – Group Name, Resource Type, Resource Name) to search on in a "Search" list and typing the desired text in a "For" box
11. Assigning Permissions to a User Group
- a. Provide a means to allow user groups access to system resources

- b. Provide an Assign Permissions tab within the User Group Configuration screen. This screen shall show a list of all system resources. Each resource shall include a checkbox to allow access to that particular resource. Provide a “filter” box with drop down menu to allow the operator to select and display a particular type of resource. Resource types shall include, but not be limited to, the following; Doors, VGUI's, Access Control System Client software, SMS client, etc
- c. Provide Check All and Uncheck All buttons for the operator to select to simplify the assignment of permissions
- 12. Assigning Rules to a User Group
 - a. Provide a means to assign rules to user groups. Assigning rules to a user group shall allow the user group's permissions to be restricted to specific days of the week, as well as specific times of the day. Provide a means to have a user group's access to activate or expire on a specific day or prevent the group from using permissions on restricted dates
 - b. Provide an Assign Rules tab within the User Group Configuration screen. Provide an ‘Allow access only on selected days of the week’ checkbox for user groups that are allowed access only on specific day(s). Provide checkboxes for each day of the week for the operator to select for days they want the user group to have access on
 - c. Provide an ‘Allow access only during time range’ checkbox for user groups that are allowed access only during specific times. Provide time configuration boxes for ‘No earlier than’ and ‘No later than’ that include the time in hours, minutes and seconds. Provide indications for “AM” and “PM”
 - d. Provide an ‘Unrestricted Access’ checkbox to select for user groups that have no access restrictions based on the time of the day and the day of the week
 - e. Provide an ‘Access has activation date’ checkbox for user groups that have permissions that should not begin until a later date. Provide a drop-down calendar tool to set the activation date
 - f. Provide an ‘Access has expiration date’ checkbox for user groups that have permissions that should expire on a certain date. Provide a drop-down calendar tool to set the expiration date
 - g. Provide an ‘Allow access on restricted dates’ checkbox for user groups that are allowed access on restricted dates
- 13. Assigning Users to a User Group
 - a. Provide a means to assign users to user groups. When a user is assigned to a user group, they receive the permissions and rules of the user group in addition to their own rules and permissions
 - b. Provide an Assign Users tab within the User Group Configuration screen. Each user in the database shall be displayed. Each user shall include a checkbox to assign the user to that particular group
- B. Administrative Configuration Functions: Provide administrative-level tools to enhance and customize the functionality of the access control system software
 - 1. Adding/Modifying/Deleting User Information Types
 - a. Provide a User Information Type screen that shall allow the administrator to create new, modify existing, or delete existing information fields for users. Information types (i.e. – address, phone number, etc.) shall be defined by the administrator on this screen. The administrator shall be capable of assigning a display order for each information field. A minimum of 1000 administrator-definable user information types shall be available

- b. Once defined, these fields shall be displayed in the User Configuration screen. Provide an Additional Information tab within the User Configuration screen. All additional information specific to a particular user shall be displayed on this tab
2. Adding/Modifying/Deleting Restricted Dates
 - a. Provide a Restricted Dates screen that shall allow the administrator to create new, modify existing, or delete existing restricted dates. Restricted Dates shall be used to control access on Holidays or other user-defined dates. Restricted dates shall be defined by the administrator on this screen. The administrator shall be capable of assigning a name, as well as a date for the restricted date on this screen. A minimum of 1000 administrator-definable restricted dates shall be available
 - b. Once defined, access on restricted dates shall granted by going to the Assign Rules tab within the User Configuration screen, and checking the 'Allow access on restricted dates' checkbox
3. Reporting Features: The access system shall have the following reporting features
 - a. User Profile Report: This report shall provide information in a document format on the user, such as full name, ID Number, and whether the account is activated or deactivated. This report shall also detail what group(s) the user belongs to, as well as what resources the user has permission to access. The rules for the user shall also be listed in the User Profile Report
 - b. Resource Report: This report shall provide information in a document format on a particular resource. This report shall detail the specific resource chosen, as well as what group and user permissions are assigned to the resource
 - c. Audit trail available historically or in real time, including standard reports that include, but not limited to:
 - 1) Invalid access attempts
 - 2) Time and attendance
 - 3) Door reader location
 - 4) Group of readers
 - 5) Individual cardholder
 - 6) Operator console activity
 - 7) History report for an alarm point(s) of state. An alarm point state shall be defined as: Normal, alarm, Trouble, Ajar
 - 8) History report for card state. A card state shall be defined as: Normal, Trace, Not Found, Anti-Pass violation, Time Zone Violation, Site Code violation or Expired card
 - d. Ability to design custom reports
4. System Backup/Restore: The access system shall have the following administration features
 - a. Database Backup: This tool shall provide a database management window, which shall allow the database files to be backed up to another directory or external media
 - b. Database Restore: This tool shall provide a database management window, which shall allow the database files to be restored from another directory or external media
 - c. Provide automatic backup procedure daily.
5. Badge Designer: The system shall have the following Badge Designer features

- a. Badge Designer Basics: This tool shall be used to create custom badge templates. A badge template can then be assigned to any number of users in order to print custom user badges. The badge designer shall be capable of creating templates for use with badges with similar requirements
- b. Badge Printing: This tool shall be used to allow for edge-to-edge card printing
6. Software shall have ability to partition control of the system by user ID.
 - a. Allow multiple administrators with partition control.
 - b. Allow a minimum of four administrators with ability to create security levels per operator.
 - c. The cardholder database must be shareable across partitions.
 - d. Must be able to create cardholders that are only accessible from a single partition.
 - e. Hardware components (locks, readers, controllers, etc.) must be able to be assigned to a particular partition or shared across multiple partitions.
7. The system shall automatically adjust the time of the system for Daylight Savings changes.
8. The system shall cause an alarm when controllers go off-line.

1.5 SUBMITTALS

- A. Refer to Section 285000 for submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Identocard
- B. Lenel/S2
- C. Galaxy Control Systems
- D. Johnson Controls
- E. RS2 Technologies
- F. MTI

2.2 ACCESS CONTROL SYSTEM (FILE) SERVER / CARD ACCESS CLIENT STATION COMPUTER

- A. Provide a ACS File Server, Card Enrollment equipment and Client stations as indicated. This file server shall be permanently connected to PLC via Ethernet. File Server and Client Station computers shall include but not be limited to the following:
 1. Access Control Software shall operate on Windows 10 or better. Software shall include Administration, Event Monitoring, Status Windows, and support multiple application windows open simultaneously.
 2. The PC-based workstations shall consist of an Intel Core i5-4570 quad core, 3.2GHz turbo processor or better, 512K cache, 8GB 1600MHz DD3 Memory, 250GB hard drive, 2 USB ports, network card for Ethernet operation, CD-ROM drive, sound card, video accelerator, running Windows 10 pro. Provide UPS power for all workstations.
 3. This spec shall be exceeded as necessary when multiple systems are combined onto one station.
 4. Approved Manufacturers:
 - a. HP

b. Dell

- B. Provide at Access Control System station a 24" or larger LCD flat panel monitor with 1280 X 1024 resolution unless otherwise noted.
1. Approved Manufacturers – Dell, Samsung, NEC, HP

2.3 MATERIALS

A. Central Equipment

1. All components used in creating the access control system shall be of the same manufacturer and/or approved by the manufacturer for system compatibility. Used products shall not be acceptable. Equipment specified herein indicates the types of equipment and the minimum quality of equipment required. It shall be the SCSC's responsibility to assure the compatibility of all access control equipment, software, programming, cable, mounting methods, etc. that are used in providing a complete, fully-functional system.
2. All central equipment power shall be provided from emergency circuits. Additional UPS or Battery Backup power shall be provided for all central equipment to provide error free operation.
3. Intelligent Controller: Supports up minimum of 8 readers. Firmware for 10,000 cardholder records and 1,000 transactions. Shall support both proximity readers and keypads simultaneously for each door. Systems shall be capable of optionally supporting LAN or WAN communications using TCP/IP.

B. Proximity Reader

1. Coordinate mounting to be 48" AFF or less and to avoid issues with trim or other devices.
2. Dimensions: 3.3" x 4.8" x .95"
3. Power Supply: 5-12 VDC
4. Current Requirements: Average – 50/75mA (12VDC)
5. Operating Temperature: -40° to 150°F (-40° to 65°C)
6. Operating humidity: 5-95% relative humidity, non-condensing
7. Transmit and Excite Frequency: 125kHz and 13.56MHz
8. The proximity reader shall be a HID Corp. model RP40 or approved equal
9. The proximity reader shall be a HID Corp. model RP10 or approved equal when mounted to Mullions or other

C. Proximity Reader/Keypad

1. Dimensions: 3.3" x 4.8" x .95"
2. Power Supply: 5-12 VDC
3. Current Requirements: Average – 50/75mA (12VDC)
4. Operating Temperature: -40° to 150°F (-40° to 65°C)
5. Operating humidity: 5-95% relative humidity, non-condensing
6. Transmit and Excite Frequency: 125kHz and 13.56MHz
7. The unit shall include an integrated weatherized keypad.
8. The proximity reader/keypad shall be a HID Corp. model RPK40 or approved equal

D. Proximity Reader Enrollment Station

1. Read Range: 1"-3" dependent upon proximity card type and environmental conditions

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2. Dimensions: 3 3/8" x 2" x 0.6"
 3. Power Supply: USB self-powered
 4. Certifications: FCC Certification, CE Mark
 5. When a proximity card or keyfob is presented to the reader, the red LED flashed green.
 6. Provide one proximity reader enrollment station per PC (with access control system software installed) that is designated as an enrollment station.
 7. The proximity reader enrollment station shall be RFIdeas model BSE-PCPRXH-U or approved equal.
- E. Proximity Keyfob
1. Dimensions: 1.90" x 0.900" x 0.550"
 2. Construction: Ultrasonically welded, ABS shell
 3. Operating Temperature: -50° to 160°F (-45° to 70°C)
 4. Read range: up to 3"
 5. Format: Shall support formats up to 85 bits.
 6. The proximity keyfob shall be a HID model 1346 series.
 7. Provide 150 keyfobs to the Owner upon final completion.
- F. Printable Proximity Access Card
1. Dimensions: 2.125" x 3.375" x 0.033"
 2. Construction: Thin, flexible polyvinyl chloride (PVC) laminate
 3. Operating Temperature: -50° to 160°F (-45° to 70°C)
 4. Read range: up to 7"
 5. Format: Shall support formats up to 85 bits.
 6. Options: Card shall include external card numbering, vertical slot punch and artwork gloss finish.
 7. The proximity access card shall be a HID model 1386-LGSMV.
 8. Provide 400 cards to the Owner upon final completion.
- G. Dual-sided Card Printer
1. General Specifications:
 - a. 102 cards/hour full color, single-sided (YMCKOK)
 - b. 4MB image memory standard
 - c. Standard card flip over feature for dual-sided printing
 - d. Bi-directional driver communication
 - e. Pass-code electronic lock
 2. Color printing:
 - a. Color dye sublimation or monochrome thermal transfer printing
 - b. 35 seconds per card full color single-sided (YMCKO/K)
 - c. 300 dpi print resolution
 - d. True Type fonts via Windows driver
 3. Card Specifications:
 - a. Types: PVC, PVC composite
 - b. Card width/length: ISO CR-80-ISO 7810, 2.12" x 3.38"
 - c. Card thickness: 30 mil (.76mm) to 60 mil (1.524mm)
 - d. Card feeder capacity: 100 cards (30 mil)

- e. Card output hopper capacity: 100 cards (30 mil)
4. Electrical/Mechanical Specifications:
 - a. 110 ~ 240 Volts AC, 50 ~ 60 Hz (auto switching)
 - b. FCC Class B, CE, UL and CUL approved
 - c. Width: 20.90" (523mm)
 - d. Depth: 10.17" (253mm)
 - e. Height: 10.76" (269mm)
 - f. Weight: 27.5lbs (12.5kg)
 - g. Operational Temperature: 60°F to 86°F (15°C to 30°C)
 - h. Operating Humidity: 20% to 65% non-condensing
 - i. Storage Temperature: 23°F to 158° (-5°C to 70°C)
 - j. Storage Humidity: 20% to 70% non-condensing
 - k. Ventilation: Free air
5. Prox card only printer shall be Zebra model ZXP Series 7 Card Printer Dual Sided.
6. Prox/Smart card only printer shall be Fargo DTC4000 Card Printer Dual Sided for smart card encoding.
7. Provide four full color print ribbons with minimum capacity of printing 250 images each.
- H. Card Printing system Accessories
 1. Provide a 12.1 megapixel digital camera equivalent to a Canon PowerShot SX40. Digital camera software package shall be installed on the PC that manages the card printing system and has the Access Control System Client software installed.
 2. Provide a digital camera tripod with 3-way Pan/Tilt head adjustment.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Check location, "roughing in", and field dimensions prior to beginning work.
- B. Do not begin installation until all unsatisfactory conditions have been corrected.
- C. Verify field measurements are as shown on Drawings and as instructed by manufacturer.
- D. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION/APPLICATION OF ALL SECURITY PRODUCTS:

- A. Field testing and inspection will be performed under the provisions of Section 285000.
- B. Replace equipment, components, & wiring as required to achieve a fully functional system

END OF SECTION 285300

SECTION 285400 – DURESS - MISC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. This section includes the requirements and operational characteristics for duress and other miscellaneous systems, which are an integral part of the Security Control System.
- B. Provide all labor, equipment, materials, and supervision to install, program, calibrate, adjust, document, and test the total system as required herein and on the Drawings.

1.3 SYSTEM DESCRIPTION

- A. Duress: Provide duress pushbutton stations as indicated on the Drawings. Each duress location shall annunciate separately at the VGUI control station in control and Central Control. Duress buttons at VGUI control stations shall lock down the VGUI controls when that duress is activated.
- B. Door Release Pushbuttons (PB): Provide pushbutton stations as indicated on the Drawings. Each location shall be an input to the PLC for verification and a request to unlock the door. PLC makes decision to open door or not. These buttons are not hardwired to the lock.
- C. Request-to-Exit Devices (REX): Request-to-Exit devices are provided by Div 8 on all controlled Div 8 doors. SCSC shall coordinate and integrate with REX devices to shunt door alarm when door is exited. The only time a REX shall be programmed to unlock a door is if the door lacks any free egress hardware.
- D. Acoustic Glass Break Sensor: Provide acoustic glass break sensors as indicated on the Drawings. Each location shall be an input to the PLC for annunciation at each VGUI control station.

1.4 SYSTEM FEATURES AND SOFTWARE REQUIREMENTS

- A. Duress Alarms
 - 1. Duress pushbutton stations shall be located in specific areas of the facility for the officers to press. Input and output signals from/to these stations shall be connected to the input and output modules of the PLC System.
 - 2. All duress alarms shall be annunciated on the VGUI control station. The owner shall have the option of duress alarms annunciating on all VGUI control stations at no additional cost.
 - 3. Duress stations are normally hidden on the VGUI control station(s). They shall be displayed during an alarm condition only.
 - 4. Upon activation of a duress alarm, the audible alarm shall continually annunciate “DURESS” until the VGUI control station is SILENCED. The Site Plan shall flash in red the area in which the duress occurred to allow quick identification for the operator to select that screen. The audio output from the nearest intercom station shall automatically

be broadcast through the VGUI control station speakers. The local VMS camera video shall be displayed on the video call-up monitor in Central Control.

5. When the area of the alarm is shown full screen, the duress icon shall flash in red at a rate of one time per second at the location of the active duress station. Multiple duress stations will be shown individually, but shall only require one silent activation. When duress pushbutton stations with illuminated mushroom head pushbuttons are used, the lamp (activated by a PLC output) in the station will flash at a rate of one time per second once activated. Deactivating the duress at the station will not cancel the alarm at the VGUI control station. The duress pushbutton station lamp will become solid once the VGUI control station has SILENCED the alarm to alert the officer in duress that the duress alarm has been recognized.
6. When the local VGUI control station presses RESET, the icon shall become solid red. The duress situation will only be canceled once the remote station has been deactivated and the VGUI control station has RESET the alarm condition. Multiple duress stations must be individually RESET.
7. All duress alarms originating from duress pushbutton stations shall only be able to be reset at the physical duress pushbutton station location, requiring direct intervention of the staff. The VGUI control station shall only be able to silence the alarm annunciation.

B. Miscellaneous Systems

1. Door Release Pushbutton (PB):
 - a. Activation of an exit pushbutton station shall request that the associated door be opened via the PLC System.
 - b. The pushbutton shall not be wired directly to the associated door's electrically powered lock, but to an input point of the PLC System. Activation of the pushbutton shall take into account all interlocking with other doors and shall not create a 'Breached Door' alarm.
2. Request-to-Exit (REX) devices: Shall provide an input signal to the PLC system to:
 - a. Shunt door alarms when exiting the door via free egress hardware.
 - b. Unlock door and shunt alarm for doors without free egress hardware.

PART 2 - PRODUCTS

2.1 Duress Pushbutton Station, Wall-mounted Mushroom Head

- A. Provide an Allen-Bradley 800-T series, illuminated, mushroom head, latching pushbutton mounted to a single-gang faceplate of 12-gauge stainless steel for all wall-mount applications. The text "DURESS" shall be laser-engraved on the faceplate.
- B. Approved equal manufacturer: General Electric.

2.2 Duress Pushbutton Station, Under-Counter

- A. The unit shall include double-pole, double-throw contacts.
- B. The unit shall be supplied with a lock-mounted switch and one key.
- C. The unit shall be designed for silent operation and housed in a stainless steel housing.

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D. For under-counter duress pushbutton stations, provide a single gang box mounted at 18" AFF with 3/8" center hole coverplate and allow 6' of flexible connection to underside of desk. Use cable tie base fasteners screwed to the walls and underside of the counter or desk. Coordinate exact placement at desks and counters with Owner.

- E. Approved Manufacturer:
1. Amseco Husk 20
 2. Honeywell 269R
 3. Approved equal.

2.3 Door Release Pushbutton, Wall (PB):

A. The switch shall be a momentary, pushbutton, dry contact type that is moisture and damage proof. The contacts shall be rated at three amperes, 300 watts AC with a non-inductive load. It shall be a single pole, single throw momentary action switch, attached to the faceplate from the rear so that it cannot be removed when installed.

B. The pushbutton shall be captive within the faceplate. It shall be constructed so that it does not provide a permanent closure or call-in indication when operated. The switch shall be mounted on a single-gang faceplate of 12-gauge stainless steel. The text "DOOR RELEASE" shall be laser-engraved on the faceplate.

- C. Approved Manufacturer:
1. Harding
 2. Southern Folger
 3. Quam
 4. Approved equal

2.4 Door Release Pushbutton, Under-Counter (PB):

A. The unit shall include double-pole, double-throw contacts.

B. The unit shall both look and function different from the under counter duress push button.

C. For under-counter duress pushbutton stations, provide a single gang box mounted at 18" AFF with 3/8" center hole coverplate and allow 6' of flexible connection to underside of desk. Use cable tie base fasteners screwed to the walls and underside of the counter or desk. Coordinate exact placement at desks and counters with Owner.

- D. Approved Manufacturer:
1. USP HUB2SA
 2. Approved equal.

2.5 Acoustic Glass Break Sensor

A. The sensor shall include the following characteristics:

1. Operational voltage: 9-16 VDC, 25mA max.
2. Relay output: Normally closed, open 4 seconds on alarm
3. Maximum loop rating: 16 VDC, 50mA
4. Operational temperature: 0°F to 120°F (-18°C to +50°C)
5. Microphone: Omni-directional 360° electrets

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6. Range: 25' measured to the farthest point of glass, 25' on the opposite wall, 20' measured to the wall
 7. Minimum distance from glass: 3.3'
 8. Glass types detected: Plate, tempered, wired or laminated glass – up to ¼”
- B. Acceptable Manufactrers:
1. Interlogix (Sentrol) 5820A
 2. Honeywell FG1625RFM
 3. Ademco 2520FM
 4. Approved equal

END OF SECTION 285400

SECTION 285500 – AUXILIARY CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SUMMARY

- A. Auxiliary control systems shall include remote control of lighting and water control.
- B. Division 22 contractor to provide solenoid valves to interface with the security control system to allow all water to be shut off at each housing unit and each holding cell. SCSC is responsible for conduit and cabling to these solenoid valves and the dry contact outputs to interface with the valves. Provide required interface to shutoff all water at each housing unit (as a group) and each holding cell, via the security control VGUI(s).
- C. Coordinate all inmate telephone connections with the Owner's telephone provider.
- D. Division 26 contractor shall provide relay enclosures and relays for all lighting control interfaces. SCSC is responsible for conduit and cabling to these panels and the dry contact outputs to interface with the relays. Coordinate all requirements with Division 26 contractor during the submittal coordination meeting as described in Section 285000. All lighting switch legs shall be wired by the Division 26 contractor.
- E. The lighting control system shall provide for remote switching of lighting circuits. Lighting control shall be implemented using electro-mechanical relays controlled through PLC output modules.
- F. Upon loss of power to the auxiliary system or failure of the PLC input and output modules, the system shall change state to the safest condition for the facility staff.
 - 1. Lighting relays shall fail closed to allow lighting to be on, if the lighting circuit is powered.
- G. Configure the system to automatically turn on lights, which are controlled, in an area from which a duress alarm has been received.
- H. Configure the system to automatically turn on all controlled lights when an emergency evacuation has been initiated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Auxiliary Control Relays
 - 1. Provide relays to switch the auxiliary circuits as scheduled. Provide one relay per scheduled device.
 - 2. Manufacturers
 - a. Omron G2R DPDT series relays with din rail terminal base
 - b. Finder
 - c. Idec
 - d. Phoenix
 - e. Approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that all areas are ready to receive work.
- B. Verify required utilities are available, in proper location and ready for use.

3.2 INSTALLATION

- A. Field testing and inspection shall be performed.
- B. Replace equipment, components and wiring as required to achieve a fully functional system.

3.3 ADJUSTING AND CLEANING

- A. When requested by Architect or Owner within one year of Substantial Completion, provide on-site assistance in adjusting levels and adjusting controls to suit actual occupied conditions.

3.4 UTILITY SCHEDULE

- A. Lighting Control Schedule: Refer to electrical relay panel schedules for lighting relay requirements.
 - 1. Include 5 spare output points for additional lighting control.
- B. Water Control Schedule: Provide water control at plumbing fixtures in Holding areas. Refer to isolation valve schedule/detail for requirements.
 - 1. Include 5 spare output points for additional water control.

END OF SECTION 285500

SECTION 285900 - SECURITY MANAGEMENT SERVER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this section.

1.2 SYSTEM DESCRIPTION

- A. The SMS data recording engine shall log security commands made within the detention facility as they happen. The SMS shall provide facility administrators the ability to monitor and review all operational aspects of the Security Control System and its operations. The intent is that by recording all actions of the system, it shall provide owner with greater liability protection and system accountability.

B. Software Requirements

1. The Security Management Server (SMS) shall have the following software requirements to allow for seamless Control and future flexibility.

a. Data Logging

- 1) The SCSC shall provide a SMS system with a single point for logging, recording, report generation and backup. Distributed databases are not acceptable.
- 2) The SMS shall be capable of processing 500,000 transactions per day (minimum).
- 3) The SMS shall be capable of communication to multiple PLCs over Ethernet.

b. Archiving & System Management

- 1) The database shall be able to contain up to 5 million transactions prior to the need to archive data.
- 2) Automatic archives shall be user configurable for frequencies of daily, weekly, monthly, quarterly, semi-annual, or yearly. In addition, the user shall be able to select the day of the week or month to create the archives.
- 3) When performing an archive, the user shall be able to select to archive only, archive and delete the archived events from the database, or delete only.
- 4) Archived events shall be viewable in an identical format as the original SMS, using the standard SMS application. The sorting, searching, and reporting generating functionality shall be identical to the standard SMS application as well.
- 5) The system shall notify the user when the transaction register reaches a user definable limit to allow for data archiving. If the database reaches the user defined limit, an automatic archive will be performed so that current logging will not be affected.
- 6) The user shall have the ability to set an expiration date for all archives stored on the SMS computer. Archives that have reached their expiration dates shall be deleted automatically to create additional hard drive space.
- 7) The system shall notify the user when the hard drive reaches a user definable percentage of free hard drive space. If the hard drive reaches the user defined limit, the archives shall be deleted automatically so that current logging will not be affected.

8) The user shall have the ability to perform a full database backup.

C. System Features

1. The Security Management Server (SMS) performs several valuable functions, but is not an essential component of any operational control system. It shall be configured as follows:
 - a. The SMS shall be connected via Ethernet to the PLC controller.
 - b. The SMS shall receive and record alarms and transactions from the PLC within 500 milliseconds of the occurrence. The SMS shall record Time/Date, Device Type, Device Name, Event Name/Description, and the name of the VGUI and operator for VGUI initiated actions.
 - c. Transactions & Alarms shall include, but are not limited to:
 - 1) The SMS shall record to disk all door activities, including unlock requests, unlocking, re-locking, secure actions, door position changes, lock status, alarms, alarm silencing, and alarm resetting.
 - 2) Changing the state of ISOLATED doors is recorded to disk by the SMS.
 - 3) All interlock override activities.
 - 4) The SMS records all intercom call activity, including when the call was placed or audio threshold alarm occurred, when the station was connected to, and when the call was disconnected.
 - 5) Every intercom pushbutton press.
 - 6) All communications ISOLATE activities.
 - 7) All Access control system activities.
 - 8) All pushbutton and request to exit activities.
 - 9) All Duress system activities.
 - 10) All video system activities.
 - 11) All Utility control activities.
 - 12) All PLC system faults.
 - 13) All VGUI login/logout activities.
 - d. All transactions (action codes), alarms and status are continually outputted from the PLC. The PLC shall be able to service this data management activity and continually control all other devices specified elsewhere in this specification without any additional delay in system throughput.
 - e. The SMS will provide preventative maintenance and enhanced analysis functions.
2. The SMS provides the following features:
 - a. If multiple VGUI stations and/or Graphic control panels and/or PLCs are provided, the SMS shall be capable of recording all events of all stations, panels and PLCs.
 - b. Transactions sent to screen, disk or printer are time and date stamped.
 - c. Provide password protection to prevent modifications to the database system.
 - d. All reports/searches shall take less than 60 seconds to generate for the most intensive retrieval.
 - e. The database reports shall include the option to export the data to a comma-separated file (CSV) or an XML file to be used by owner provided software.
3. The SMS will include a complete comprehensive relational database report utility. All reports are titled and time and data stamped. It shall be possible to easily select reports to show the history of any device or group of devices between specified times and dates.

4. The user shall have the ability to easily display all of the events or to filter the events based on the device type (ex: doors or cameras) or based on a specific device (ex: 'Front Door').
5. The user shall be able to quickly display events for pre-defined time periods such as previous hour, previous 24 hours, previous 7 days, etc.
6. The user shall have the ability to perform an advanced search which allows the operator to select any and all transaction types, alarms, watchtour, time changes and any other system functions as described in the specifications, and is done by defining a start date and time and a stop date and time. The computer will search any applicable matching occurrences and print either to the screen or printer as a report; thus allowing searching for:
 - a. Specific date/time ranges
 - b. Specific device types
 - c. Specific device names
 - d. Specific keyword
 - e. Any combination of the above

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Computer Hardware configuration

1. The server shall have the following minimum requirements:
 - a. Processor: Intel Xeon E5-2609v3, 1.9GHz, 15MB Cache, 6 Cores
 - b. Operating System: Window Server 2016
 - c. Internal Memory: 32GB, DDR4, 2133 MHz
 - d. Storage: 3-500GB 6G SAS Hard Drives (1.5TB total)
 - e. Storage Type: RAID 5
 - f. Network: 4-Gigabit Ethernet Ports
 - g. Power Supply: Dual, Hot Swappable
2. The server shall have a licensed copy of the HMI software installed.
3. The server shall be administered remotely using any control station on the security network.
4. Approved Manufacturers:
 - a. HP
 - b. Dell
5. Server shall connect to KVM being used for the Video Management System.

END OF SECTION 285900

SECTION 323113.53 – HIGH-SECURITY CHAIN-LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
1. Security chain-link fences.
 2. Security Gates:
 - a. Manual operation swing.
 - b. Horizontal sliding motor operation.
 3. Fence accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated-Design Submittal: For chain-link fences, fence cap panels, and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and is registered in the state where the project occurs.
- B. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Line Post Design: Provide line posts of size indicated but not less than sizes required to comply with ASTM F1043 with post spacing not to exceed 10 feet, in resisting the following wind-load criteria, based on fence height, mesh size, and pattern indicated:
 - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed and exposure category indicated on the Structural Drawings and according to ASCE 7-10, as referenced in CLFMI WLG 2445, 2016 edition.
 - b. Fence Framework Material Group: Provide either IA, ASTM F 1043, Schedule 40 steel pipe or IC, electric-resistance-welded round steel pipe.
 2. Fabric Tension: Provide fences in which fabric deflections do not exceed **2.5 inches (64 mm)** when tested by applying a 30-lbf (133-N) force at midpoint between rails and horizontally between posts for every eighth lower panel along the fence line.
 3. Fence Post Rigidity: Provide fences in which post deflections do not exceed **3/4 inch (19 mm)** when tested by applying a 50-lbf (222-N) force at mid-height of every eighth post along the fence line.
- C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review required testing, inspecting, and certifying procedures for fencing and grounding.

2. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
3. Review gate operator interface with security control system.
4. Review sequence of operation for each type of gate operator.
5. Review coordination of interlocked equipment specified in this Section and elsewhere.

1.5 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates:
 1. Fence and gate posts, rails, and fittings.
 2. Chain-link fabric, reinforcements, and attachments.
 3. Gates and hardware.
 4. Gate operator, including operating instructions and motor characteristics.
 5. Accessories:
 - a. Barbed wire.
 - b. Barbed tape.
- B. Shop Drawings:
 1. Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories.
 2. Indicate materials, dimensions, sizes, weights, and finishes of components.
 3. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
 4. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 5. Wiring Diagrams: Power and control wiring.
 - a. Gates are controlled remotely from touchscreen. Review interface requirements and operational sequences with Division 28 Security Control System Subcontractor (SCSC), Architect, and Owner.
- C. Delegated-Design Submittal: Refer to 1.3.A. and 1.3.B under "Performance Requirements" above.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of chain-link fence and gate, signed by product manufacturer.
 1. Strength test results for framing according to ASTM F 1043.
- B. Qualification Data: For Installer.
- C. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Administrative Requirements" and 1.4.A above.

1.8 PROJECT CONDITIONS

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

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of security chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. Chain-Link Fence Fabric: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage. Comply with ASTM A 392, CLFMI CLFS 2445, and with requirements indicated below:
 - 1. Steel Wire Fabric: Metallic coated.
 - 2. Fabric, 12 feet and 16 feet high
 - a. Wire Diameter:
 - 1) 9 gage minimum, unless indicated otherwise.
 - b. Mesh Size: 2 inch.
 - c. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 2, 2.0 oz/sq. ft. (610 g/sq. m) with zinc coating applied before or after weaving.
 - d. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
 - 3. Selvage: Twisted and barbed top and bottom.

2.2 SECURITY FENCE FRAMEWORK

- A. Posts and Rails: Comply with ASTM F 1043 for framing of the following material group and strength requirement for fences of height indicated:
 - 1. Framework Material Group: IA, round steel pipe, Schedule 40 or IC, round steel pipe with a yield strength of 50,000 psi (345 MPa).
 - 2. Fence Height: As indicated on the Drawings.
 - 3. Strength Requirement: Heavy industrial fence according to ASTM F 1043.
 - 4. Post Diameter and Thickness (for Standard and Security Fence): Provide posts of minimum sizes indicated below that comply with ASTM F 1083.
 - a. Line Post: 4 inches.

- b. End, Corner, and Pull Post: 4 inches.
- c. Swing Gate Post: According to ASTM F 900.
- 5. Post Diameter and Thickness (for fence cap panels): Provide posts of minimum sizes indicated below that comply with ASTM F 1083.
 - a. Top Rail: 1.66 inches.
 - b. Line Post: 2.375 inches.
 - c. End, Corner and Pull Post: 2.875 inches.
- 6. Metallic Coating for Steel Framing:
 - a. External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm-) thick, zinc pigmented coating.
- B. Top Rails: Fabricate top rail from lengths 21 feet or longer, with swaged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric, 1.660 inch OD minimum.
- C. Intermediate Rails: Match top rail for size, coating and strength and stiffness requirements.
- D. Bottom Rails: Match top rail for size, coating and strength and stiffness requirements.

2.3 TENSION WIRE

- A. General: Provide horizontal tension wire at the following locations:
 - 1. Location: As indicated.
- B. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 824 and the following:
 - 1. Metallic Coating: Type I, aluminum coated (aluminized), with the following minimum coating weight:
 - a. Class 3: Not less than 2.0 oz./sq. ft. (610 g/sq. m) of uncoated wire surface.

2.4 SWING GATES

- A. TyMetal Corporation's 2150 Pedestrian Swing Gate System is an acceptable alternative to shop-fabricated gates as specified in 2.4.B through 2.4.D below. Gates shall be provided fully factory-assembled and shipped to the project site ready for installation.
- B. General: Comply with ASTM F 900 for single and double swing gate types, as indicated.
 - 1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.
- C. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:
 - 1. Gate Fabric Height: 2 inches (51 mm) less than adjacent fence height.
 - 2. Gate Leaf Width: As indicated.
 - 3. Frame Members:
 - a. Tubing Size: 1.90 inches (48 mm) round, minimum.
 - 4. Provide custom fabrications including mounting plates and housings to receive security detention locks, gate position switch, and other devices provided by Division 11 Detention Equipment Contractor (DEC) and Division 28 Security Control System Contractor (SCSC). Coordinate closely with (DEC & SCSC) supplier of such equipment

and devices; obtain templates (if required) and confirm dimensional requirements prior to fabrication.

- D. Frame Corner Construction:
 - 1. Welded and 3/8-inch- (9.5-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.
- E. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame 12 inches (305 mm), or as indicated, as required to attach barbed wire assemblies.
- F. Hardware:
 - 1. Hinges for gates not indicated to receive security detention locks: Offset type, galvanized malleable iron, 180-degree swing.
 - 2. Hinges for gates with security detention locks: Provide self-closing hinge(s) at gates.
 - 3. Latches for gates not indicated to receive security detention locks: Provide latches permitting operation from both sides of gate. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
 - 4. Lock Housings and Brackets for security detention locks: Provide galvanized custom fabrications indicated to receive locks and security devices specified in Division 11 Section "Security Hardware" and Division 28 Section "Security Control System."

2.5 HORIZONTAL-SLIDE GATES

- A. General: ASTM F 1184 for gate posts and single sliding gate types:
 - 1. Classification: Type I Overhead Slide.
 - 2. Basis-of-Design: Tymetal Corp.; PLUS Sliding Gate System or approved equivalent meeting or exceeding basis-of-design product. Ground-mounted operators, exposed chain or rails are not acceptable.
 - a. Gate frame: Welded construction, 2-3/8" O.D. galvanized steel pipe, with galvanized steel bottom angle.
 - b. Operation: Fully automatic by remote electronic control from designated security control station with a fully-enclosed drive assembly.
 - c. Post-mounted motor box with emergency hand crank and paracentric prison lock.
 - d. Drive assembly shall be as recommended by the manufacturer to suit project conditions.
 - e. Keyless three-point locking.
 - f. Coordinate with requirements of Division 28 for interface with security control system.
- B. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, rollers, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- C. Hardware:
 - 1. Hangers, Roller Assemblies, Stops, Bottom Guides: Manufacturer's standard hardware and components.
 - 2. Lock: Manufacturer's standard internal device, complete with lock cam assembly, locking column, lock bar, lock bar guides, and cover.

2.6 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Post and Line Caps: Each post.
 - 1. Line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top-Rail Sleeves: Pressed steel or round steel tubing not less than 6 inches (152 mm) long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line to line posts.
 - 3. Provide off-set type devices as required to secure top, intermediate, and bottom rails at "oversize" post conditions, such that face of rails and post are in plane and chain-link fabric may be installed without distortion.
- E. Tension and Brace Bands: Pressed steel, 0.105 inch (2.66 mm) thick, with 1.2-oz/sq. ft. (366-g/sq. m) metallic (zinc) coating.
- F. Tension Bars: Steel, length not less than 2 inches (51 mm) shorter than full height of chain-link fabric with 1.2-oz/sq. ft. (366-g/sq. m) metallic (zinc) coating. Provide one bar for each gate and end post, and two for each corner and pull post unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, integral with post cap; for each post, unless otherwise indicated, and as follows:
 - 1. Line posts with arms designed with opening to accommodate tension wire or top rail, if indicated.
 - 2. Arms shall accommodate three (3) strands of barbed wire and double coil of barbed tape, as indicated.
 - 3. Corner arms at fence corner posts, unless extended posts are indicated.
 - 4. Type I, single slanted arm, unless indicated otherwise.
 - 5. Bolts or rivets for connection to post.
- I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. High-Security Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Metallic-Coated Steel: 0.192-inch- (4.88-mm-) diameter wire.
 - b. Weight of Aluminum Coating: ASTM A 809, 0.4 oz/sq. ft. (122 g/sq. m).
- J. Power-Driven Fabric Fasteners: Type 304, 0.0938-inch- (2.38-mm-) thick, specially designed cap to anchor fabric to framing with a power-driven, heat-treated, knurled pin.
- K. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) of zinc.

2.7 BARBED WIRE

- A. Zinc-Coated Steel Barbed Wire: Comply with ASTM A 121, Design Number 12-4-5-14R for the following 2-strand barbed wire:
 - 1. Standard Size and Construction: 0.099-inch- (2.51-mm-) diameter line wire with 0.080-inch- (2.03-mm-) diameter, 4-point round barbs spaced not more than 5 inches (127 mm) o.c.
 - 2. Metallic Coating for Barbed Wire: ASTM A 121 Class 3, not less than 0.80 oz/sq. ft. (245 g /sq. m) of zinc.

2.8 BARBED TAPE

- A. Wire-Reinforced Tape (Razor Ribbon): ASTM F 1910; continuous coils with four-point, needle-sharp barbs permanently cold clenched around a core wire.
 - 1. Core Wire: High-tensile-strength, zinc-coated steel, or stainless steel.
 - 2. Configuration: Double coil.
 - 3. Style: Concertina pattern.
 - 4. Coil Diameter(s): 24 inches inner coil and 30-inch outer coil.
 - 5. Coil Loop Spacing(s): 12 inches.
 - 6. Barb Length Classification: Medium, 0.4-inch
 - 7. Barb Spacing: 4 inches o.c.
 - 8. Barb Set: Manufacturer's standard.
- B. Clips: Stainless steel, 0.065 inch (1.7 mm) thick by 0.375 inch (9.5 mm) wide, capable of withstanding a minimum 150-lbf (667-N) pull load to limit extension of coil, resulting in a concertina pattern when deployed.
- C. Tie Wires: Stainless steel, 0.065 inch (1.7 mm) in diameter.

2.9 CAST-IN-PLACE CONCRETE

- A. Materials: Portland cement complying with ASTM C 150, Type I, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/ C 94M.
 - 1. Concrete Mixes: Normal-weight concrete, air entrained, with not less than 3000-psi (20.7-MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25.4-mm) maximum size aggregate.
- B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.10 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.11 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper or Aluminum.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1 inch (25.4 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Listed in UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic welded type.
 - 2. Grounding Rods: Copper-clad steel.
 - a. Size: 5/8 inch by 96 inches (16 mm by 2440 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
- B. Coordinate post locations with all underground utilities and structures, and building foundation systems.

3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches (51 mm) above grade or to same elevation as concrete grade beam; shape and smooth to shed water, unless indicated otherwise.

- b. Concealed Concrete: Top 4 inches (102 mm) below grade, or as indicated on Drawings, to allow covering with surface material. Provide at concrete “mow strip” as indicated; not required at paving areas.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on the Drawings.
- D. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid-height of fabric 6 feet (1.8 m) or higher, on fences with top rail and at $\frac{2}{3}$ fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Barbed Wire Arms: Bolt or rivet to top of post. Angle single arms away from approach side of fence, unless otherwise indicated.
- G. Tension Wire: As required, install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wires in locations indicated before stretching fabric.
- H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- I. Bottom Rails: Install bottom rails spanning between posts. Anchor rail at mid-span to concrete “mow strip” as detailed on the Drawings.
- J. Chain-Link Fabric: Apply fabric to secure side of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
 - 1. Leave 2 inches (51 mm) between finish grade or surface and bottom selvage, unless otherwise indicated.
 - 2. Overlapping Fabric: At or between post or rail, overlap 6 inches (152 mm) and secure with wire ties or steel strap method.
- K. Concrete Grade Beams (Vehicle Sallyport Sliding Gate): Cast-in-place concrete, depth not less than 24 inches (610 mm) below grade and as indicated on Drawings; slope top surface to drain.
- L. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (381 mm) o.c.
- M. Tie Wires: Power-fastened or manually fastened ties configured to wrap a full 360 degrees around rail or post and a minimum of 1 complete diamond of fabric. Twist ends one and one-half machine twists or three full manual twists, and cut-off protruding ends to preclude untwisting by hand.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches (305 mm) o.c. and to braces at 24 inches (610 mm) o.c.

- N. Power-Driven Fasteners: Fasten 0.192- or 0.148-inch (4.87- or 3.76-mm) wire fabric with 2- or 1-inch (51- or 25.4-mm) mesh size.
 - 1. Fasten fabric to line posts 12 inches (305 mm) o.c. and to braces 24 inches (610 mm) o.c.
- O. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- P. Barbed Wire: Install barbed wire uniformly spaced as indicated on the Drawings. Pull wire taut and install securely to extension arms and secure to end post or terminal arms.
- Q. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.5 GATE INSTALLATION

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

3.6 GROUNDING AND BONDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding."
- B. Fence Grounding: Install at maximum intervals of 100 feet (30 m) except as follows:
 - 1. Gates and Other Fence Openings: Ground fence on each side of opening.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (457 mm) below finished grade.
- C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (152 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location, including the following:
 - 1. Each Barbed Wire Strand. Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.
- D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- E. 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 will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- F. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence, and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
 - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
 - 3. Report: Prepare test reports, certified by testing agency, of grounding resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Horizontal Sliding Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
 - 1. Test and adjust operator, controls, and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 2. Lubricate operator and related components.
- C. Lubricate hardware and other moving parts.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION 323113.53

SECTION 338116
RADIO ANTENNA TOWER

PART 1 - GENERAL

1.1 SUMMARY

- A. This work consists of construction of a new radio antenna tower to support the Owner's radio antennas.
- B. The new tower shall meet or exceed the current American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA) 222-H, Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures, Class IV standard.
 - 1. The tower shall be designed and installed as a Class IV structure as defined in ANSI/TIA 222-H.
 - 2. This standard provides detailed requirements to meet or exceed to furnish and install a stable, immovable tower that will not twist or sway (against wind and ice loading) in support of point-to-point communications links such as microwave, free space optics, etc.
- C. Grounding of the tower shall be done in accordance with Motorola R56®, Standards and Guidelines for Communication Sites at minimum. Other standards such as TIA-222, NCBC, and job specifications will supersede, if more stringent.
- D. Contractors shall adhere to the specifications detailed in federal, state, and local building codes, standards, or regulations.
- E. The tower shall be a 150-foot, self-supporting tower, and shall be furnished and installed as described in this Section.
- F. This work shall include ice bridge, grounding, and bonding to provide a turn-key tower for Owner's use.
- G. This work shall include reinforced concrete foundations and pad.
- H. Coordinate all work including pathways with other trades.
- I. The actual antenna and mounting devices will be provided by the owner's selected radio vendor and will not be the responsibility of this Contractor.
- J. The Contractor shall perform a review of the National Environmental Policy Act (NEPA) study conducted as part of the building project, including a Section 106 coordination, or determination as required by Federal Communications Commission (FCC) and/or another governing federal agency.
- K. The Contractor shall be responsible for a four-point (Wenner) method soil resistance testing; providing a tower grounding system design to meet specifications within this section providing the engineered construction design of the foundations needed; and supplying, delivering, and installing the tower and accessory items.
- L. Contractor shall procure all required permits, inspections, approvals for this work.

1.2 REFERENCE DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. ASTM International (ASTM):
 - 1. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

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2. ASTM C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
 3. ASTM C1202 - Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
- C. The European Committee for Standardization (CEN):
1. EN 1433 - Drainage channels for vehicular and pedestrian areas. Classification, design and testing requirements, marking and evaluation of conformity.
- D. Contractor shall comply with the most recent edition of the referenced Codes and Standards, unless noted otherwise.
- E. Motorola R56 – Standards and Guidelines for Communications Sites, latest issue
- F. NFPA 70 National Electrical Code
- G. Lightning Protection Institute (LPI)-175, Standard of Practice for the Design – Installation – Inspection of Lightning Protection System
- H. American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA) 222-H, Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures, Class IV standard.
- I. ANSI/TIA-568-E - Series - Generic Telecommunications Cabling for Customer Premises
- J. ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

1.3 SUBMITTALS

- A. Product Data:
1. Manufacturer's data sheets on each product to be used.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Typical installation methods.
- B. Shop Drawings: Include details indicating layout, dimensions, materials, components, and accessories.
1. Foundation Design
 - a. The foundation and tower shall be designed to support initial and future attachments as identified by the Owner or its representative and as listed in Section 2.2.
 - b. A complete structural report including all calculations shall include sufficient information to allow the engineer of record to review the proposed tower foundation design thoroughly.
 - c. Detailed drawings of tower structure and foundations shall be sealed by a professional engineer (P.E.) registered in the State of North Carolina and competent in civil and structural design. Submittal and seal shall attest that the design is in full compliance with the mechanical, structural, and electrical parameters established by these specifications.
 2. Tower Design Calculations and Drawings
 - a. The tower design and structural calculations and erection drawings.
 - b. Complete structural calculations shall include sufficient information to allow an independent engineer to review the designs thoroughly.
 - c. Drawings shall include tower name and height; manufacturer's name and model number; elevation and plan views indicating tower orientation, tower height and antenna azimuth; and section assembly information, including tower

- members, part numbers, accessories, and appurtenances.
- d. The tower and tower foundation shall be designed to support proposed antennas, side arms, mounting hardware, and cable loading and an additional 50% growth.
- e. Provide detailed drawing of the tower lightning protection system.
- f. Drawings, certifications, and design calculations shall be prepared by a P.E. licensed and registered in the State of North Carolina.

1.4 Tower Construction

- A. The tower and components shall be fabricated from solid steel protected by hot-dip galvanizing or other approved methods to prevent rusting.
- B. Sections shall be attached to each other using flange plates.
- C. Welding shall be done in the factory prior to the galvanizing process. Field welding is not acceptable.
- D. The Contractor shall provide drawings for the structure and foundation for approval by the Owner and its representative prior to manufacture.
- E. Drawings and certifications shall be sealed by a North Carolina-licensed and registered P.E.
- F. The Contractor shall be responsible for required signage at the sites.
- G. Signage shall meet Motorola R56 minimum signage and Town requirements.
- H. The geotechnical study, from the GC, may be referenced for foundation design. In the event the Contractor believes the report is inconclusive, the selected Contractor is advised to perform additional geotechnical study to determine soil conditions at the tower location.
- I. Concrete Test - Compressive strength test results shall be provided to the Owner's representative and engineer for review prior to the first concrete pour. The target for compressive strength shall meet the design requirements specified by the tower designer.
 - 1. Tower Foundation
 - a. The tower manufacturer shall provide the tower foundation and structural design based on the geotechnical study from the soil survey from the GC.
 - b. The foundation for the tower structure shall be in accordance with the design and manufacturer's specifications.
 - c. The tower support piers shall have their rebar electrically connected to the tower anchoring bolts. All anchoring bolts and the rebar cage shall be electrically bonded. The components shall be properly connected to the grounding electrode system. Refer to Motorola R56 for requirements including conductor sizes.
- J. Tower Climbing and Installation Safety Practices
 - 1. Because tower installation requires working at heights, the Owner requires that all work be done in a safe manner. The Contractor shall submit a written environmental safety and health program, including the following:
 - a. When any work on an antenna support structure is being performed above ground level, there must always be at least two certified competent tower climbers onsite. All personnel working on the tower or in the tower compound must wear hard hats during these times.
 - b. All tower climbers and their supervisors must have completed an OSHA-approved tower climbing safety and rescue course, such as those offered by ComTrain or Tractel, within the last five years. At least one person within the

- Contractor's company must have completed the course within the last year to bring others in the company up to date with any new changes in safety regulations, requirements, and procedures. The Contractor must submit certification cards for its personnel with its response.
- c. An industry-standard rescue bag must be ready at the tower site whenever a climber is working on a tower. The bag must include at least one 400-foot, properly rated rescue rope with an appropriate safety pulley system and all necessary items to allow the safe lowering of an injured worker. The Contractor must supply evidence that it owns at least one of these kits.
 - d. All climbers must always wear a full-body safety harness—with the appropriately approved shock-absorbing safety lanyard attached to a single D-ring at the top of the climber's back—when on a tower. Each climber must be issued, equipped, and use fall-protection equipment that must ensure a 100% tie-off while climbing. All fall protection and safety equipment must meet ANSI and OSHA standards and may be inspected by the Owner or its representatives at any time during the project.
 - e. A pre-climb safety meeting is required before each climbing of an antenna support structure. A log of such meetings is required and may be inspected by the Owner at any time during the project.
2. The Owner may perform unannounced safety inspections at any time during the project; this in no way infers that the Owner has accepted any liability for any safety procedure, equipment condition, safety condition, or work action taken by the selected Contractor, regardless of whether the Owner was aware of the procedure, condition, or work action. The Owner has the right, as solely determined by the Owner, to inform the selected Contractor of any actions, procedures, conditions, or equipment that it deems to be unsafe or potentially hazardous. The Owner also reserves the right to halt work on the site until such a time that the Owner agrees that the action, procedure, condition, or equipment has been returned to a safe condition. No additional charges will be incurred by the Owner for the above work stoppage.
 3. All standards, best safety practices must always be followed when working at the radio sites. The selected Contractor shall be solely and completely responsible for the safety and supervision of its employees and any other persons engaged by the Contractor for this project.
 4. Contractor must submit a copy of their written drug and alcohol policy, including information on what drug and alcohol testing policies are currently used by the Contractor.
- K. Warranty Documentation: Submit manufacturer's two-year warranty for labor and material.
- L. Manufacturer Qualifications:
1. Company specializing in manufacturing products specified in this section with a minimum of ten years documented experience.
 2. Manufacturer's Project References: List of successfully completed radio site system projects, including project name and location.
- M. Contractor Qualifications:
1. Company specializing in performing Work of this section with minimum five years documented experience with projects of similar scope and complexity.
 2. Installer's Project References: List of successfully completed drainage channel system projects, including project name and location, name of architect, and type and quantity of drainage channel systems installed.
 3. Employ persons trained for installation of drainage channel systems.

- N. Source Limitations: Provide each type of product from a single manufacturing source to ensure compatibility and uniformity.

1.5 PRE-INSTALLATION CONFERENCE

- A. Hold a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, General Contractor, and all trades involved.
- B. Agenda Shall Include:
1. Materials.
 2. Schedule.
 3. Responsibilities.
 4. Critical path items
 5. Approvals.
 6. Installation.
 7. Adjusting.
 8. Cleaning.
 9. Safety and Protection.
 10. Coordination with other Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor is responsible for transporting, storage, and management of all equipment and components for this complete turn-key radio antenna tower, and all costs associated with.
- B. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- C. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
1. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 2. Store materials in clean areas, protected from exposure to harmful conditions.
- D. Protect from damage, and construction operations.

1.7 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tower Structures - Tower requirements shall be as follows:
1. One 150-foot, self-supporting solid-leg tower
 - a. Valmont V-Series
 - b. Rohn
 - c. or approved equal.

2.2 Antenna Load

- A. The Contractor shall account for antenna side arms, standoffs, and mounting hardware to support the proposed and antenna systems in the design of the tower.
- B. The brackets used for design purposes shall be the 6' standoffs.
- C. Loading of the tower is in the drawing and table below:

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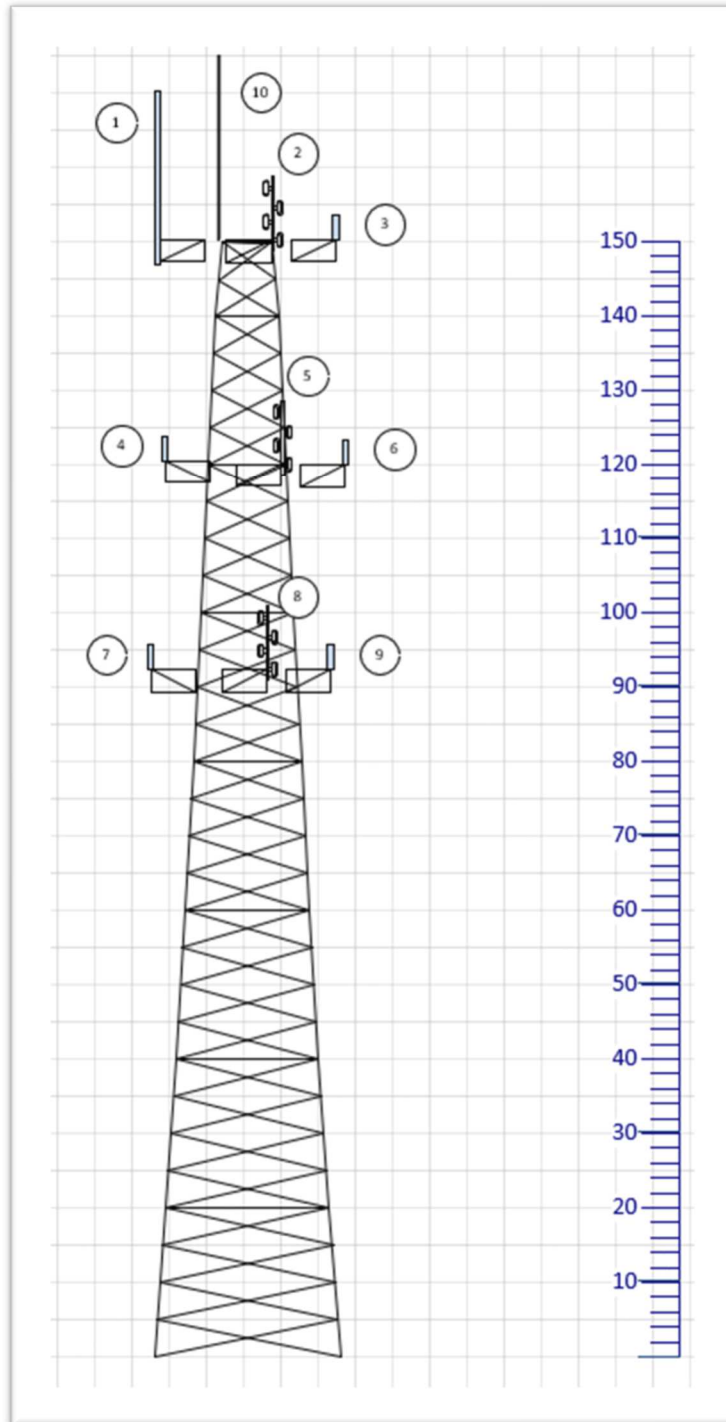


Figure 1 Savannah Rd Tower Loading

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#	Height(ft)	Leg	Description	Mount	Feedline
1	150 [Base]	A	SC251D [23.3' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
2	150 [Base]	B	BA80-67-DIN [10' DIPOLE ARRAY]	6' SIDE ARM	AVA5-50 [7/8" COAX]
3	150 [Base]	C	SC433 [3.5' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
4	120 [Base]	A	SC433 [3.5' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
5	120 [Base]	B	BA80-67-DIN [10' DIPOLE ARRAY]	6' SIDE ARM	AVA5-50 [7/8" COAX]
6	120 [Base]	C	SC433 [3.5' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
7	90 [Base]	A	SC433 [3.5' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
8	90 [Base]	B	BA80-67-DIN [10' DIPOLE ARRAY]	6' SIDE ARM	AVA5-50 [7/8" COAX]
9	90 [Base]	C	SC433 [3.5' OMNI]	6' SIDE ARM	AVA5-50 [7/8" COAX]
10	150[Base]	A	5' Lightning rod on 20' extension	Tower	N/A

2.3 Climbing Access

- A. A ladder or AHJ approved climbing devices, beginning at a point above ground, shall be included as an integral part of the tower to permit access by authorized personnel.
- B. These devices shall be designed and installed so that it rises in a straight line from base to top. Ladders having both angled and vertical combinations shall not be acceptable.
- C. The ladder shall be equipped with an OSHA-approved anti-fall safety device.
 - 1. This device shall not interfere with the climber's ease of reach by hand or foot from one rung of the ladder to the next, either going up or coming down.
- D. A portable section of ladder shall be included to provide access to the permanent ladder on the tower. This ladder shall be designed and constructed so that it is securely held to the tower and firmly supported at the bottom when in use. Clamps, hooks, or similar devices shall be acceptable for securing the top and bottom of the ladder in a vertical position. Anti-climb hardware will be provided and installed for the bottom ten feed of the ladder.

2.4 Cable Ladder

- A. The transmission line shall be anchored to the tower using hardware recommended by the transmission line manufacturer for that type of tower.
- B. Transmission lines shall not be installed in a way that will impede climbing or safety devices.
- C. Transmission line installation should be planned with consideration for future expansion.
- D. Spacing of anchoring hardware shall be at 3-foot intervals maximum unless the RF cable manufacturer requires less distance between supports. The width shall accommodate planned RF cabling and 50% growth for each cable quantity.

PART 3 EXECUTION.

3.1 SITE EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 SITE PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Anticipated Antenna Load
 - 1. The Contractor shall account for antenna side arms, standoffs, and mounting hardware to support the proposed antenna systems in the design of the tower.
 - 2. The brackets used for design purposes shall be the 6" standoffs.
- B. GROUNDING SYSTEM
 - 1. The selected Contractor shall install a buried ground ring system to provide a common, single-point ground for the tower.
 - 2. Tower grounding shall be installed per the following procedure:
 - a. The grounding electrode system shall have an earth/ground resistance of 5 ohms or less.
 - b. Chemical ground electrode enhancement material shall not be used in the initial design.
 - c. The Contractor shall verify the installed system meets the 5 ohms or less requirement by using a Fall-of-Potential Test.
 - d. The test shall be witnessed by the Owner, GC and design team.
 - e. Test results shall be published within a typed document and photos provided showing setup, intent, execution, and results.
 - f. If testing proves that the 5 ohms requirement was not met, the Contractor shall propose a remediation design and a proposal that provides the best possible value for the Owner, GC, and design team to review. Use of chemical electrode grounding is not a preferred solution.
 - 3. The grounding system shall meet applicable standards, including the following:
 - a. Subterrain
 - b. Tower
 - c. Compound equipment
 - d. Ice bridge
 - e. Lighting and controls
 - f. Heating, ventilation, and air conditioning (HVAC)
 - g. Fencing and access gates
 - 4. The main point of connection for all ground conductors within the compound shall be at the primary bonding bar (PBB).
 - a. The PBB shall be bonded to the external grounding electrode system (ground ring) via a properly sized grounding conductor.
 - b. An internal perimeter bonding bus (IPBB), secondary bonding bar (SBB) and/or rack bonding bar (RBB) may be installed when multiple grounding

- conductors are needed to bond numerous items to the ground system.
 - c. The IPBB, SBB and/or RBB will be bonded to the PBB either directly or through each other progressively, per Motorola R56 specifications.
 - d. A 2/0 bare, tinned, stranded copper conductor ground ring shall be installed.
 - e. Each tower leg shall be bonded to the tower ground ring via a 2/0 bare, tinned, stranded copper conductor.
 - f. The conductor shall be attached to the tower leg, preferably via exothermic weld (unless strictly prohibited by the manufacturer) or by an irreversible tin-plated copper crimp lug. A two-hole lug is preferred, although not always practical due to anchoring restrictions.
 - g. If by lug, the conductor shall attach to the tower leg via existing holes or by sharing existing mounting bolts. No holes will be drilled into the tower.
 - h. Stainless steel (300-series) hardware with lock washers and nuts shall be used to fasten lugs to the tower leg. Nylon-locking nuts shall not be used.
 - i. The tower leg shall be cleaned, and an antioxidant coating compound shall be applied between the tower leg and the lug. The other end of the grounding conductor shall be attached to the tower ground ring conductor via exothermic welding at the point of attachment of a ground rod. This conductor shall be attached as vertically and downward toward the tower ground ring conductor as possible. Conductor bending radius shall be 8 inches or more and not less than a 90-degree angle; 120-degree is preferable.
 - j. The top of the ground rod shall be driven to the same depth as the ground ring conductor (i.e., 30 inches deep or below the frost line). The more stringent shall apply.
 - k. The ground rods shall be attached to the ground ring by exothermic welding. It may be necessary to dig out additional earth around the top of the ground rod to allow easier exothermic welds to the ground ring.
 - l. A ground ring (tower ground ring) shall be installed encircling the tower base at a minimum of 2 feet from the base of the concrete pad or piers.
 - m. The tower ground ring shall be bonded to the building grounding system in two locations. Connections of the two ground ring conductors shall be via an exothermic weld, and the bonding radials shall be spaced 10 feet apart, minimally.
 - n. If the tower and building foundations are closer than 11 feet and does not allow proper installation for two ground rings, then one may be used.
 - 1) The tower ground shall tie into the building grounding system.
 - 2) A minimum of three radial conductors shall be installed, radiating away from the tower and building.
 - o. All beneath-grade connections and attaching of ground ring bonding jumpers to the external ground bus bar (EGB) and tower ground bus bar (TGB) shall be via an exothermic weld.
- C. Radial Grounding Conductors (when required)
- 1. Radial grounding conductors shall be sized and installed in the same manner as the ground ring conductor.
 - 2. The tower shall have three radial conductors, minimally, and shall radiate away from the structures.
 - 3. Radial conductors shall be sized between 25 and 80 feet and of different lengths (i.e., +or- 5%).
 - 4. The tower radials shall attach to the tower base and weld to the ring where they cross.

5. Radial conductors radiating from the building ground ring shall bond to the ring where they cross.
 6. Test wells shall be installed on the radial at the connection to the ground ring.
 7. If space does not allow installation of straight radial conductors, ground plates, grids, or a crow's foot configuration, as per the illustration in Lightning Protection Institute (LPI)-175, Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems, may be used.
- D. Tower Ground Bus Bar Installation
1. The tower ground bus bar (TGB) minimally shall be ¼-inch thick, 2 inches wide, and 12 inches in length.
 2. The bar shall be made of tin-plated copper material.
 3. Hole spacing for each connector shall be at least ¾-inch on center.
 4. A TGB shall be installed at the bottom of the tower where the planned transmission line vertical run meets the horizontal run toward the building. This height shall be coordinated with the Owner.
 5. A TGB may be installed at the top of the tower within 6 feet of where the transmission lines turn to run down the tower. This will provide a convenient grounding point for the transmission line ground kits.
 6. Additional TGBs may be installed to maintain maximum spacing between transmission line ground kits at less than 75 feet.
 7. The TGB shall be mounted to the tower frame via conductive fasteners suitable for preventing corrosion from dissimilar metals. This will reduce impedance to earth.
 8. The bottom tower TGB shall be bonded to the tower ground ring via two 2/0 stranded, bare, tinned copper conductors or by means of direct attachment, thus fewer insulators. The attachment shall be made via stainless-steel hardware.
 9. Each conductor shall attach to the bottom left and right corners of the TGB, respectively, via an exothermic weld.
 10. The grounding conductors from the TGB to the ground ring shall be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the TGB as physically possible. This is not only for conductor protection, but also will reduce step potential on the ground near the conductors and deter incidental contact with the tower.
 11. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.
 12. Non-conductive strapping on the PVC conduit is preferred.
 13. The conduit and/or grounding conductor shall be supported within 3-foot intervals.
 14. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.
 15. The other end of the conductors shall be connected to the tower ground ring conductor using an exothermic weld.
 16. Several practices shall be followed to allow for neat and secure grounding and wiring.
 17. When stripping insulation from ground conductors, only the required amount of insulation needed to be removed shall be removed. Reference R56 sections 4.8.2 and 5.8.2.
 18. All ground conductors shall be kept as short as possible. Reference R56 sections 4.6.2 and 5.6.6.7.
 19. No braided conductor shall be used in the grounding system. Reference R56 sections 4.6 and 5.6.6.

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20. Grounding/bonding conductor bending radius shall be 8 inches or more and not less than a 90° angle; 120° is preferable. The conductor shall be run in a manner that is direct to the grounding electrode system. No short bends or narrow loops shall be permitted as this would increase the conductor's impedance to ground and may cause flash points. Although, this is not always the most aesthetically pleasing, it is the best method to drain off surges. Reference R56 sections 4.6.2 and 5.6.6.3.
21. Paint or galvanic coating shall always be removed prior to making metal-to-metal connections. After attachment, the connection and bared metal area shall be recoated to prevent oxidation. Reference R56 sections 4.8 and 5.8.4.
22. Surfaces shall always be cleaned before making connections. Reference R56 sections 4.8 and 5.8.4.
23. All metal-to-metal connections shall be treated with an approved antioxidant compound to avoid oxidation and corrosion. Reference R56 sections 4.8.6 and 5.8.6.
24. All ground connections shall be made in the direction of the direct path to ground. Reference R56 sections 4.6.2 and 5.6.6.7.
25. Beneath grade connection to the grounding system shall be done by exothermic weld or high-compression irreversible crimp. Reference R56 section 4.8.1.
26. Proper sized irreversible crimped lugs and compression taps shall always be used. The tap shall be insulated with green electrical tape to inhibit incidental contact. Reference R56 sections 4.8.2, 5.8.2 and 5.8.10.
27. Mechanical set-screw lugs and split-bolt style bugs shall NOT be used. Reference R56 sections 4.8.2, 5.8.2, and 5.8.10.
28. Stainless-steel 300-series hardware shall be used for mechanical attachment of lugs, clamps, etc.; an exception would be if bolt and hardware is same material as the bus bar (ex: copper bus bar with copper alloy bolts). Reference R56 sections 4.8.3 and 5.8.3.
29. Sheet metal or Tech-style fasteners shall not be used for continuous electrical bonds. Per NEC® two-threads shall be engaged within the bonding surface. Reference R56 section 5.8.1.
30. Two-hole tin-plated copper irreversible crimp lugs shall be used to attach ground conductors to bus bars and ancillary equipment. There are some exceptions, but two-hole lugs are the preferred method over one-hole lugs, thus, preventing movement. Reference R56 sections 4.8.2 and 5.8.1.
31. One-hole tin-plated copper irreversible crimp lugs may be used on rack ground bus bars (RKBs) for equipment bonding only; although, two-hole is preferred and when bonding to equipment that only has one grounding stud (ex: power distribution unit). Reference R56 sections 5.8.1, 5.8.2, 5.8.9.3, and Table 5-5
32. Clamping devices used for grounding and bonding shall be listed for the application and material shall be compatible with conductors and items being grounded/bonded. As an example, bonding steel or aluminum metallic objects shall be bonded by using tin-plated copper or stainless-steel clamps. Reference R56 section 5.9.1.8.
33. Use of shrink tube or wrapping with electrical tape on compression lugs is required to prevent incidental contact. Reference R56 section 5.8.10.
34. Wire and cable ties shall be trimmed back. Reference R56 section 9.10.6.2.
35. Bare and/or insulated cabling shall be secured with conductor compatible clamps; nylon "P-Ring" type cable clamps may be best. Closed loop ferrous metallic clamps shall not be used. Reference R56 sections 4.6.3, 5.9 and 9.10.1.2.
36. Interior ground conductors shall be green insulated copper stranded conductors; an exception would be plenum areas that may require bare conductors. Reference R56 section 5.6.6.1.

37. Grounding conductor insulation shall be rated for its environment. Reference R56 section 5.6.6.1.
 38. Grounding conductors are to maintain at least 2-inch spacing from other cable groups (4-inches from RF transmission cabling). The exception is when conductors come together, as they are entering the same piece of equipment and where they cross over one another at a 90° angle. Reference R56 section 5.6.6.4.
 39. Grounding conductors shall be protected against abrasion while passing through metallic enclosures. This must be done per NEC® standards. Reference R56 sections 4.6.3 and 5.6.6.5.
 40. If the hole that the conductor passes through is slightly larger, the conductor shall be bonded to the metallic enclosure. If the hole is larger, enough to accommodate several conductors (allowing at least 2 inches between conductor and ferrous metal enclosures), then the conductor does not have to be bonded to enclosure. Reference R56 section 5.6.6.4.
 41. All unused existing cabling and grounding components currently present and after completion of the grounding enhancement shall be removed or abated properly. Reference NFPA 70 and R56 Chapter 9.
 42. Where physical damage may occur or incidental contact of other metallic media, the bonding/grounding conductor should be protected by non-conductive conduit. Generally, a flexible conduit is used, although there may be cases where ridged would work better. Either is acceptable. Reference R56 sections 4.6.3, 4.6.5.3, 4.7.4, 5.6.1.5 and 5.6.6.6.
 43. If metallic conduit is specified by the project, the two ends of the conduit shall be bonded to the ground conductor per NEC®. All metallic boxes used as handholes and pull boxes shall be bonded to the ground conductor. Reference R56 section 4.6.3.
 44. When factory, NEC® minimum bending radius conduit is used, the conduit size shall not exceed 1-1/2" conduit. Reference R56 sections 4.6.2 and 5.6.6.3
 45. On exterior installations the conduit shall start 6 - inches below grade (up to 16-inches is preferable) and extend a minimum of 6 feet above grade or as near to conductor connection as feasibly possible. This is not only for conductor protection but will reduce step potential on the ground near the conductors. Reference R56 section 4.6.3.
 46. For exterior installations, all wall penetrations and the top and bottom, if applicable, of the conduit and around the grounding conductor shall be sealed with a silicone sealant. This will inhibit weather elements and wildlife migration. Reference R56 section 3.7.2.
 47. The grounding conductors shall be supported within 3-foot intervals, minimally, or per project specifications. The more stringent shall apply. Reference R56 sections 4.6.3 and 5.6.6.6.
 48. All local or jurisdictional codes and safety standards shall be followed. These shall supersede standards and/or procedures mentioned in this document. This includes but is not limited to NEC® and OSHA. Reference R56 section 4.1.
- E. Exterior Equipment Grounding
1. The Contractor shall bond all metallic ancillary equipment within 10-feet of the exterior grounding system or a grounded object to the earth grounding system to reduce negative step and touch potentials and protect outdoor equipment from possible damage.
 2. Metallic objects shall be bonded to the external grounding electrode system as follows:
 - a. A No. 2 AWG solid, tin-plated bare conductor, minimally.

- b. One end of the conductor shall be exothermically welded to the ground ring.
 - c. The other end shall be attached to the equipment via two-hole, tin-plated copper, high-compression, irreversible lugs, and stainless-steel bolts, lock washers, and nuts. Nylon lock nuts shall not be used.
 - d. Where physical damage may occur, the conductor shall be protected by PVC conduit. No metallic conduit is to be used. The conduit shall begin 16 inches below grade and extend to a minimum of 6 feet above grade. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.
 - e. Non-conductive strapping on the PVC conduit is preferred.
 - f. The conduit and/or grounding conductor shall be supported within 3-foot intervals.
 - g. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of same material as the conductor or installed per the technique for joining dissimilar metals.
3. The area to which the lug is to be applied shall have all paint removed (burnished) down to bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and the surface to which it is attached. After attachment, the connection and bared metal area shall be recoated to prevent oxidation.
- F. Metallic objects that are bonded to the grounding electrode system by buried electrode bonding conductors or radial conductors shall be attached to the external grounding system in the same manner as bonded metallic objects, with the exception of using main sized conductor AWG, bare, copper-stranded, tin-plated conductor and installing additional grounding electrodes along the buried bonding and radial conductors as described within this RFB. Reference the ground ring and radial conductor sections within this RFB.
- G. A main sized conductor is the grounding electrode and/or lighting protection system (LPS) main sized conductor as established by the facility project. The more stringent shall apply.
- H. A list of metallic objects bonded by buried bonding and radial conductors, but not limited to, on the exterior that shall be grounded to the earth ground system follows. The list is only for reference and objects include:
- 1. Generator chassis
 - 2. Generator steps and work platforms; removable platform parts shall have bonding jumpers installed
 - 3. Generator fuel supply tank (if allowed)
 - 4. Large wall-hung cabinets
 - 5. Light poles
 - 6. Flag poles
 - 7. Fence posts
 - 8. Ice bridge
 - 9. Tower
 - 10. Storage tanks above or below grade (if allowed)
 - 11. Support masts.
 - 12. Any other grounding electrode systems
 - 13. Any pad-mounted equipment (including larger HVAC units)
 - 14. Steel facility housings
 - 15. Pad-mounted HVAC units.
- I. Tower Grounding

1. The Contractor shall install a tower ground ring encircling each tower at a minimum of 2 feet from its concrete tower base or leg piers. The tower structure shall be bonded to the tower ring at each leg. The minimum number of ground rods around the ring shall be equal to the number of tower legs. Additional ground rods may be required to maintain proper ground rod spacing requirements.
 2. Tower grounding shall be installed per the following procedure:
 - a. A main sized conductor bare, tinned, stranded copper conductor ground ring shall be installed.
 - b. Each tower leg shall be bonded to the tower ground ring via a main sized conductor bare, tinned, stranded copper conductor.
 - c. If the tower is a monopole, it shall be bonded to the tower ground ring via three equally spaced main sized conductors.
 - d. The conductor shall be attached to the tower leg, preferably via exothermic weld (unless strictly prohibited by the manufacturer) or by an irreversible tin-plated copper crimp lug. A two-hole lug is preferred although not always practical due to anchoring restrictions.
 - e. If by lug, the conductor shall attach to the tower leg via existing holes or by sharing existing mounting bolts. No holes will be drilled into the tower.
 - f. Stainless-steel (300-series) hardware with lock washers and nuts shall be used to fasten lugs to the tower leg. Nylon locking nuts shall not be used.
 - g. The tower leg shall be cleaned, and an antioxidant coating compound shall be applied between the tower leg and lug. The other end of the grounding conductor shall be attached to the tower ground ring conductor via exothermic weld at the point of attachment of a ground rod. This conductor shall be attached vertically and downward toward the tower ground ring conductor as possible. Conductor bending radius shall be 8 inches or more and not less than a 90-degree angle; 120-degree is preferable.
- J. Ice Bridge Grounding
1. The Contractor shall isolate the ice bridge from the tower and shelter where possible.
 2. Bonding jumpers shall be installed, on both sides, where the ice bridge makes a mechanical splice to itself and/or the tower and shelter.
 3. When an ice bridge is supported by the shelter and tower, the use of a slip-joint fiberglass fastener can be used to support the ice bridge to the tower. This will both isolate the bridge and allow for seismic adjustment.
 4. A self-supported ice bridge shall have support posts bonded to the ground ring system by a main sized conductor bare, tinned, stranded copper conductor. The conductor shall be exothermically welded to both the leg and ground ring.
 5. A self-supporting ice bridge shall maintain a 6-inch separation between the tower and shelter structures.
 6. Ice bridge support legs shall be grounded to the exterior grounding system. Each support leg shall be bonded to either the tower or shelter ground rings, whichever is closer. Pairs of support legs (across the width of the ice bridge) may share a common grounding conductor. This may be accomplished via exothermically welding a tail of equal size to the grounding conductor beneath earth.
 7. Each section of the ice bridge shall be bonded to the support legs via a No. 2 AWG, solid, tinned copper conductor. The conductor shall be exothermically welded to the leg and shall be attached to the ice bridge via exothermic weld or irreversible two-hole, high-compression, tinned lug, and stainless-steel hardware including lock washer.

8. If multiple ice bridge sections are used, they shall be bonded at their splice point via a No. 2 AWG, solid, tinned copper conductor. The conductor shall be attached by exothermic weld or irreversible two-hole, high-compression, tinned lug, and 300-series stainless-steel hardware including lock washer.
 9. The area to which the lug is to be applied shall have paint removed (burnished) down to bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and surface to which it is attached.
 10. All bared metallic surfaces after grounding/bonding attachment shall be properly recoated to inhibit oxidation.
 11. The grounding/bonding conductor bending radius shall be 8 inches or more and not less than a 90-degree angle. The conductor shall be run in a manner that is direct to the grounding electrode system. No short bends or narrow loops shall be permitted as this would increase the conductor's impedance to ground and may cause flash points.
 12. Exothermic welds on legs and other galvanized equipment bonds shall be treated with a coating of cold-galvanizing spray (Valmont #B364 or equivalent) to prevent corrosion and oxidation.
- K. Exterior Ground Bus Bar Installation
1. The Contractor shall position the EGB just below the ice bridge and entry port to the shelter.
 2. The EGB shall be sized according to the number of antenna transmission lines entering the shelter.
 3. The EGB shall be mounted to the shelter beneath the entry port via stainless-steel mounting brackets, hardware, and insulators (polyester fiberglass, 2 kilovolts [kV] minimum voltage rating).
 4. The EGB minimum size shall be ¼-inch thick, 2-inches wide, and length determined by the number of antenna transmission cables being grounded and provide for 50% growth.
 5. The bar shall be of tin-plated copper material.
 6. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate a two-hole irreversible crimp connector for each antenna transmission cable grounding conductor.
 7. The EGB shall be bonded to the exterior shelter grounding system via two main sized conductors stranded, bare, tinned copper conductors.
 8. Each conductor shall attach to the bottom left and right corners of the EGB respectively via irreversible high-compression crimp or exothermic weld.
 9. The grounding conductors from the EGB to the ground ring shall be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the EGB as physically possible. This is not only for conductor protection; it also will reduce step potential on the ground near the conductors.
 10. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.
 11. Non-conductive strapping on the PVC conduit is preferred.
 12. The conduit and/or grounding conductor shall be supported within 3-foot intervals.
 13. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.
 14. The other end of the conductors shall be connected to the ground ring conductor using an exothermic weld.

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- L. Tower Ground Bus Bar Installation
1. The TGB minimal size shall be ¼-inch thick, 2-inches wide (4-inch preferred), and 12 inches in length.
 2. The bar shall be sized for 50-percent growth for future tower loading.
 3. The bar shall be of tin-plated copper material.
 4. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate a two-hole irreversible crimp connector for each antenna transmission cable grounding conductor and provide for 50% growth.
 5. A TGB shall be installed at the bottom of the tower below the transmission line grounding kit near the point where the transmission line vertical run meets the horizontal run toward the shelter. When transmission lines are run underground via PVC conduits, the TGB shall be mounted below the top of the conduits.
 6. A TGB may be installed at the top of the tower within 6 feet of where the transmission lines turn to run down the tower. This will provide a convenient grounding point for the transmission line ground kits.
 7. Additional TGBs may be installed to maintain maximum spacing between transmission line ground kits at less than 75 feet.
 8. The TGB shall be mounted to the tower frame via conductive fasteners suitable for preventing corrosion from dissimilar metals. This will reduce impedance to earth.
 9. The bottom tower TGB shall be bonded to the tower ground ring via two main sized conductors stranded, bare, tinned copper conductors or by means of direct attachment, thus less insulators. The attachment shall be made via stainless-steel hardware.
 10. Each conductor shall attach to the bottom left and right corners of the TGB, respectively, via exothermic weld.
 11. The grounding conductors from the TGB to the ground ring shall be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the TGB as physically possible. This is not only for conductor protection, but also will reduce step potential on the ground near the conductors and deter incidental contact with the tower.
 12. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.
 13. Non-conductive strapping on the PVC conduit is preferred.
 14. The conduit and/or grounding conductor shall be supported within 3-foot intervals.
 15. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.
 16. The other end of the conductors shall be connected to the tower ground ring conductor using an exothermic weld.
- M. Cable Ladder Tray (Ladder Runway) Grounding
1. Grounding conductors shall be installed to the interior far side or exterior of the tray. Cable groups shall maintain a 2-inch clearance from other cable groups. Exception: RF transmission cables for transmitting stations shall maintain a 4-inch minimum clearance from the power, data, and signal cable groups.
 2. The cable and/or ladder tray shall be grounded to the PBB or SBB.
 3. A No. 6 AWG, copper, stranded, green-jacketed conductor shall bond to the tray via a two-hole, tin-plated, copper, irreversible crimp lug.
 4. The other end shall be attached to the PBB or SBB via a two-hole, tin-plated, copper, irreversible crimp lug.
 5. If the tray is a single straight unit running away from the ground bus, it only shall be

required to be bonded at one point back to the PBB or SBB.

6. If the tray is parallel to the ground bus, it shall be bonded to the PBB or SBB in both directions by two individual bonding conductors.
7. If the tray is shaped in a "U" configuration and running parallel to the ground bus, it shall be bonded on both sides of the "U" that are closest to the ground bus back to the PBB or SBB.
8. The tray shall not be used as a grounding conductor.
9. All tray splices and joints shall have a No. 6 AWG, copper, stranded, green-jacketed conductor bonding jumper with a two-hole, irreversible crimp lug on each end.
10. When the tray, its splicers, and interconnecting components are labeled as suitable for grounding purposes, jumpers shall not be required.

N. Grounding Components

1. The radio communications site is a newly developed tower site collocated with a (greenfield) facility construction project. The Contractor shall install a new grounding system for the exterior, tower, and any other ancillary support equipment.
2. Ground Rod Installation
 - a. The ground rods that are to be used for this project shall be copper-clad steel, 10 feet in length and 3/4-inch in diameter.
 - b. The ground rods have a slightly beveled (pointed) tip at one end to allow for easier driving of the rod into the earth.
 - c. Ground rods shall be driven to a depth of no less than 30 inches below grade, or beneath the frost-line. The more stringent shall apply. This shall be done by excavating (usually a trench) in the area in which the rod will be driven.
 - d. Ground rods shall be driven exactly vertically into the earth. If rock prevents this, the ground rods may be driven at a 45-degree angle. This method shall only be used in the most extreme circumstances and otherwise is not recommended. If rods cannot be driven, as noted above, ground plates shall be used in lieu of ground rods and installed per Motorola R56.
 - e. The ground rods shall be driven 12.5 feet to 18.75 feet apart.
 - f. If heavy clay soil is encountered, it is strongly recommended that a pneumatic jackhammer be utilized to drive the rods. Clay soil is very hard and manual driving of the rods is next to impossible.
 - g. Care shall be used to avoid damaging the top end of the rods while driving them into the earth. If a ground rod is damaged, a few inches shall be cut off from the end of the rod. The top end of the rod shall be clean and shiny to facilitate a proper exothermic bond.
 - h. Attachments to the ground rods shall be done using an exothermic weld. No mechanical connections to the ground rods are permitted under any circumstances.
 - i. When the exothermic weld has cooled, it shall be struck with a hammer to ensure a positive weld connection has taken place.

O. Labeling and Identification

1. The make, model, and serial number shall be clearly labeled near the base of the tower.
2. The tower height in feet shall be clearly labeled near the base of the tower.
3. Latitude and longitude in degrees/minutes/seconds shall be clearly labeled near the base of the tower.
4. FAA and FCC identification numbers, if applicable, shall be clearly labeled near the

base of the tower.

5. Labeling shall be weatherproof and durable, such as a stamped metal plate or equivalent. Labeling can be attached to a leg or cross brace.

P. Tower Finishing

1. The area of the tower compound shall be graded level and tamped with sod and large stones removed.
 - a. Backfilled soil shall be graded level and tamped.
 - b. Care should be given not to damage any underground cabling, grounding, or other infrastructure.
2. Sod, large rocks, and other debris shall be removed.
3. Pre-existing asphalt, concrete, sub-course, and grassy areas that have been excavated are to be returned to their original condition.
4. The sub-course shall be restored to the requirements of the site plan, and certified compaction testing is required.

Q. Tower Lightning Protection System (if required)

1. Air terminals (lightning rods) shall be properly installed on the tower per NFPA 780, Standard for the Installation of Lightning Protection Systems; Underwriters Laboratories (UL); and this bid document. The more stringent shall apply.
 - a. Air terminals shall be compatible with the tower structure, stainless-steel rods are preferred, and have a Class 2 rating (minimum).
 - b. Air terminals shall be directly attached to the tower legs by approved methods.
 - c. When using air-terminal extension rods, a proper size and material down lead shall be used and properly attached to the top extreme of the leg.
 - d. Copper or copper-alloy air terminals, conductors, or attachment hardware shall not be used on galvanized towers. Stainless steel is recommended. Tinned copper and aluminum are acceptable.

3.4 Final Testing and Acceptance

- A. During installation and upon completion, the tower installation shall be inspected and tested to verify compliance with the manufacturer's requirements.
- B. The selected Contractor shall provide the Owner with as-built documentation and contractual documents.
- C. At substantial completion, the Contractor shall conduct a site walk with the Owner's representative to complete punch lists.
 1. Substantial completion shall be defined as when the Respondent has completed the installation, so it is fit to be used for its intended purpose.
- D. The Contractor shall correct punch-list items within 30 days of substantial completion, unless otherwise noted in contract documents.
- E. Closeout documentation shall be provided within 30 days of substantial completion, unless otherwise noted in contract documents. Each document shall be provided on USB and downloadable PDF format shall be furnished in tabbed and organized format.
- F. The following items minimally shall be part of the closeout documents.
 1. Operator manuals
 2. Installation manuals
 3. Approved submittals
 4. Spare part list

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5. Tower and site stamped and/or approved drawing and specification packages.
 6. Inspection reports, e.g., concrete, compaction, etc.
 7. Red-line as-build drawings
- G. The Contractor shall conduct follow-up inspections.
- H. Upon completion of the work, documentation detailing final inspection and testing shall be submitted, addressing the following:
1. Steel structure:
 - a. Vertical alignment and plumb
 - b. Bolts tight and torqued to specification.
 - c. No damaged or missing structural members.
 - d. No signs of stress or vibration
 - e. Climbing ladders and other devices installed correctly.
 - f. Labels and tags
 2. Foundation:
 - a. Concrete finish/lack of cracks/blemishes
 - b. Backfilling and grading
 3. Grounding:
 - a. Verify lugs and exothermic welds.
 - b. Ground resistance test and record.
 4. Ice bridge:
 - a. Installed per specification.
 5. Photographs:
 - a. Overall structure from north, east, south, and west
 - b. Footers
 - c. Grounding and lightning protection documented for both beneath- and above-grade applications.
 6. The selected Contractor shall coordinate with the Owner for third-party inspections to verify the structure and ancillary equipment has been installed per project specifications.
 7. Concrete Test
 - a. Compressive strength test results shall be made available to the Owner's representative and engineer for review prior to the first concrete pour. The target for compressive strength shall meet the design requirements specified by the tower designer.
 - b. Prior to erecting steel, the selected Contractor shall provide the Owner's representative and engineer with a sample of each truckload of concrete tested for compliance with the foundation specifications set forth by the tower engineer. Written reports certifying the strength of the concrete shall accompany each test cylinder.
 - 1) Tests are to be conducted, minimally, at seven days and 28 days after the foundation is poured to ensure that the concrete meets the specifications set forth in the foundation design.
 - c. If any concrete used in the foundation does not meet specifications, the selected Contractor shall be required to remove the foundation and pour one utilizing compliant materials at the selected Contractor's expense.
 - d. If any concrete used in the foundation does not meet specifications, the selected Contractor shall remove the foundation and re-pour using compliant materials at no expense to the Owner.
 - e. Testing of composite samples of fresh concrete, obtained according to

- American Society for Testing and Materials (ASTM) C172, Standard Practice for Sampling Freshly Mixed Concrete, shall be performed according to the following requirements:
- 1) Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cubic yards (cu. yd.), but less than 25 cu. yd., plus one set for each additional 50 cu. yd., or a fraction thereof.
 - f. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd., or fraction thereof, of each concrete mixture, placed daily.
 - 1) When the frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - g. Slump: ASTM C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete; one test at the point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - h. Air Content: ASTM C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method; pressure method for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - i. Concrete Temperature: ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete; one test hourly when the air temperature is 40 degrees (°) Fahrenheit (F) and below and when 80° F and above, and one test for each composite sample.
 - j. Unit Weight: ASTM C567/C567M, Standard Test Method for Determining Density of Structural Lightweight Concrete; fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - k. Compression Test Specimens: ASTM C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field:
 - 1) Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - 2) Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 - l. Compressive-strength Tests: ASTM C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens:
 - 1) Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - 2) Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - 3) Compressive-strength test shall measure the average compressive strength from a set of two specimens obtained from the same composite sample and tested at the age indicated.
 - I. Apply silicon sealant to make joints watertight.
 - J. Install temporary blank grate inserts to keep concrete, sediment, and debris out of channel drains during installation of drainage channel system.
 - K. Concrete:
 1. Place concrete beneath and on both sides of drainage channel system in accordance with specified load rating and as indicated on the Drawings.

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2. Minimum Concrete Compressive Strength: 4,000 psi at 28 days.
 3. Concrete: Specified in Section 03 30 00.
- L. Recess Top of Drainage Channel System:
1. Pedestrian Applications: 1/8 inch below concrete finish grade.
 2. Traffic-Bearing Applications: 1/4 inch below concrete finish grade.
- M. Allow concrete to cure to specified compressive strength.
- N. Ensure sediment and debris does not collect in drainage channel system.
- O. Install channel grates in accordance with manufacturer's instructions to meet load rating.

3.5 FIELD QUALITY CONTROL

- A. Acceptance of the site will not be granted until all testing has been completed, reviewed, and approved by the Owner.
- B. A two-year warranty for all equipment and labor shall start at substantial completion. Unless otherwise noted in contract documents.
1. The warranty shall include all labor and materials to correct any deficiencies.
 2. All deficient equipment shall be replaced with new. An additional one-year warranty includes labor and material, of the newly installed equipment shall start after the correction of the deficiency has been accepted by the AHJ.

3.6 CLEANING AND PROTECTION

- A. Clean drainage channel system of accumulated sediment and debris before final project completion.
- B. Protect Work of this Section to ensure that, except for normal weathering, Work will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 338116

SECTION 00410 – PROOFROLLING Revision Date October 12, 2021
Town of Burgaw Standard Specifications

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This item shall consist of furnishing and operating, at the direction of the Town, heavy pneumatic tired compaction equipment or fully loaded tandem dump truck for compacting the roadbed and testing the roadbed for stability and uniformity of compaction.
- B. The Contractor may operate the proofrolling equipment at times other than when directed by the Engineer. Such use is at the Contractor's option and is not to be considered as work performed under this section and will not be considered for payment.
- C. The requirement for proofrolling may not be eliminated or modified without the approval of the Engineer.

PART 2 - PRODUCT

2.1 EQUIPMENT

- A. The Engineer shall check to see that the equipment conforms to the requirements of this article. A tandem dump truck legally fully loaded (not less than 28 tons) with soil or stone may be used to proofroll.
- B. If requested weight tickets signed by a licensed public weighmaster may be used to determine the weight of the dump truck and the weight of load to be used.
- C. Requests by the Contractor to substitute other types of equipment shall be forwarded to the Engineer for approval or disapproval.
- D. The Contractor shall not be permitted to drive the loaded dump truck over existing structures or curbing. The Contractor shall use rubber tired or other types of tractive equipment for operation on the roadbed. The Contractor shall protect all structural facilities within the project area, such as, but not limited to, bridges, box culverts, pipe culverts and utilities. Damage resulting from proofrolling equipment shall be repaired by contractor at no cost to the Town. The entire assembly, including motivating equipment, shall be capable of executing a 180° turn.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Proofrolling is to be done when the roadbed is within plus or minus 0.5 foot of finished grade and the roadbed shall be rolled for a width located between points 2 feet outside the proposed edges of pavement including shoulder pavement.
- B. A coverage is considered to be that stage in the rolling procedure when the entire area to be proofrolled has been in contact with the pneumatic tires of the roller or loaded dump truck. One complete coverage shall be made with additional coverage as required when failure is suspected. Areas which have failed and been repaired shall be given a complete coverage after repair has been completed.
- C. Equipment shall be operated at a speed between 225 ft/min and 300 ft/min.

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- D. The Engineer shall follow (walking is preferable) a short distance behind the proofroller observing the action of the roadbed produced immediately behind the tires of the roller. When the roadbed material compresses and remains compressed, the roadbed is satisfactory. When the roadbed material compresses and then rebounds to any appreciable extent, further testing and investigation shall be made. Horizontal slippage or crust breakage is not considered as failure. Any slippage or breakage shall be repaired.
- E. The Engineer shall take immediate steps to determine the cause of any failure observed. Failures are usually due to the necessity for underdrains, unsuitable materials or excessively wet materials. These conditions may be found to be as much as 6 feet below the roadbed surface. Assistance in determining corrective action required when needed, may be obtained from the Engineer.
- F. Should it be determined that the failure is due to negligence or weather, the Town shall so inform the Contractor, verbally and in writing and shall document all work (including equipment, personnel and time) necessary for correction of the area.

END OF SECTION 00410

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SECTION 00415 – SOIL TYPE BASE COURSE Revision October 12, 2021
Town of Burgaw Specifications

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section consists of the construction of a base composed of one or more natural materials proportioned and blended on the road, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans and established by the Engineer.
- B. Conditioning Existing Base: The work covered in this section consists of scarifying, shaping, and compacting the existing base to conform to the required lines, grades, depths, and typical sections established by the plans or modified by the Engineer.

1.2 DESIGN REQUIREMENTS

- A. The soil type base course is to conform to the Table below:

<u>Requirements</u>	<u>Limits Type A</u>	<u>Limits Type B</u>	<u>Limits Type C</u>
Passing 2" Sieve		100%	
Passing 1" Sieve	100%	70% - 100%	
Passing ½" Sieve		55% - 100%	
Passing No. 4 Sieve		35% - 100%	
Passing No. 10 Sieve	65% - 100%	25% - 65%	100%
Passing No. 40 Sieve		15% - 45%	
Passing No. 200 Sieve		5% - 25%	

- B. The base course material shall be free from vegetative matter and lumps or balls of clay.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Soil type base course shall be either Type A, B, or C.

2.2 SOURCE QUALITY CONTROL AND TESTS

- A. Samples will be tested for gradation in accordance with AASHTO T-88. The liquid limit test will be in accordance with AASHTO T-89 and the plasticity index will be tested in accordance with AASHTO T-90.
- B. Gradation testing shall be performed a minimum of one test per road or every 2,000 feet for roads less than 27 feet in width and every 1,000 feet for roads greater than 27 feet in width.
- C. Sand cone test shall be utilized for density testing. Density testing shall be performed a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Soil type base course shall be placed on a sub-grade that has been cut to the required depth as shown on the plans. Sub-grade should be checked by the inspector or
- B. Engineer before any base course can be placed. Upon the placing of the base material the Contractor shall start mixing operations. Mixing shall be done in a manner which will produce a thoroughly and uniformly mixed soil base course.

END OF SECTION 00415

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SECTION 00420 – AGGREGATE BASE COURSE Revised October 12, 2021
Town of Burgaw Specifications

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.

1.2 REFERENCES

- A. Standard Specifications for Roads and Structures: Section 520, most recent edition by the North Carolina Department of Transportation will govern the work under these specifications except as they are modified hereinafter.

1.3 SCHEDULING

- A. No aggregate base course will be laid until the sub-grade is approved for grade and density by the Engineer.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL AND TESTS

- A. Gradation testing may be required by Engineer if visible segregation in material is noted.
- B. Sand cone test shall be utilized for density testing. Density testing shall be performed a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.

END OF SECTION 00420

SECTION 00425 EXCAVATION AND BACKFILL Revision Date October 12, 2021

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roadway: This item shall consist of the removal and satisfactory disposal of all materials excavated within the area of the street to be paved, the removal and replacement of unsuitable sub-grade material with satisfactory material, the formation, compacting, and shaping of all embankments to the lines and grades established by the Engineer, excavation from borrow areas of suitable materials to be hauled in and used as fill or back-fill, when sufficient quantities of suitable material are not available from the roadway, all in accordance with this section of the specification, and subject to the terms and conditions of the contract. The classification of all material excavated shall be either "Unclassified Excavation" or "Undercut Excavation."
- B. Storm Sewer: The Contractor shall provide labor, equipment and material to perform required excavating, backfilling and compacting for storm sewer utilities and related structures to the depths shown on the plans or as directed by the Engineer. The width of the trench shall not exceed the width required to properly tamp backfill material around pipe or to adequately shore trench, but shall be limited to pipe diameter plus two feet or pipe diameter plus ½ pipe diameter, whichever is greater.
- C. All pipes shall be laid true to lines and grades shown on the plans or as designated by the Engineer. Recesses shall be excavated to receive the bells of the pipe.
- D. When the foundation materials are of poor supporting value, the pipe foundation shall be reinforced by one of the following methods:
 - 1. By replacing the unsuitable material in a minimum depth of six inches, or as directed by the Engineer with sand, sand-clay, gravel or crushed stone and thoroughly tamped.
 - 2. By constructing supporting cradles of concrete under each joint.
- E. Excavation below grade shall be back-filled at the Contractor's expense, as directed by the Engineer, and thoroughly tamped. When select borrow material is required by the Engineer, it shall be paid for as Select Borrow.
- F. The ground adjacent to all excavation shall be graded to prevent surface water running in.
- G. The Contractor shall, at his expense, remove by pumping or other means approved by the Engineer any water accumulated in the trench.
- H. All banks or trenches shall conform to Town and OSHA safety standards (whichever more stringent). The Contractor shall, at his expense, do all bracing, sheeting, and shoring necessary to perform and protect all excavations, as required for safety, and as directed by the Engineer or when the Contractor deems it necessary.
- I. The excavation for manholes and catch basins shall be of sufficient width and depth to permit ready construction.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. P Construction Methods: The Contractor shall proceed with excavation and disposal of material at such locations and in such sequence as the Engineer may approve.
 - 1. All excess excavated material from a project shall be disposed of by the Contractor at his expense unless ordered to another project by the Engineer. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any right of property in any material taken from any excavation.
- B. Sub-Grade: The sub-grade shall be graded and regulated either by hand labor, the use of one-man motor graders or other approved methods. The sub-grade of the area to be paved shall be in a true plane parallel with and to the grade line established by the Engineer. Should soft or yielding places develop in the sub- grade, the unsuitable material shall be removed and replaced with suitable material and thoroughly compacted. Care shall be taken to ensure that all utility excavations have been thoroughly backfilled and compacted. Any settlement evident after base has been placed shall be corrected at the Contractor's expense. No soil, sand-clay or other base material shall be placed on the sub-grade until the sub-grade has been checked and approved by the Engineer. A variation of more that one-half inch (½") shall be cause for rejection of the sub-grade. Compaction testing for subgrade and for base is 100% compaction.
- C. Unclassified Excavation: All excavation of every description and of whatever substance including rock and rock-like material encountered shall be to the lines and grades indicated or otherwise as specified. The classification of all material excavated shall be "Unclassified Excavation." The work shall consist of the excavation, placement, compaction or satisfactory disposal of all materials encountered within the limits of the work, necessary for the construction of the roads, parking lots, building pads, and utilities. Suitable material excavated shall be transported to and placed in fill areas within the work limits. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. All excess unsuitable excavated material from the project shall be legally disposed of by the Contractor at his expense.
- D. Undercut Excavation: All undercut excavation consists of the excavation, placement, and compaction and/or satisfactory disposal of materials removed from a location below finished grade roadway cross section.
- E. Drainage Ditches: Drainage ditches shall be excavated in accordance with the plans, sections, and grades, and at the time directed by the Engineer. No deviation from alignment, grade, or section will be allowed except by the Engineer.
 - 1. The Contractor shall, in general, be required to excavate all drainage ditches in proper sequence or at the time directed by the Engineer. All roots, stumps, and objectionable matter in the sides and bottom of the ditch shall be cut to conform to the slope, grade, and shape of the section. The Contractor shall dispose of the excavated material as directed by the Engineer and no excavated material or spill from a drainage ditch shall be deposited or left within three feet of the edge of the ditch, but shall be scattered back and

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not left piled up in a ridge along the ditch, unless otherwise shown on the plans or directed by the Engineer in writing.

- F. Removal of Old Pipe, Walls, Steps, Curb, Gutter, Sidewalk and Pavement: All old pipe, walls, steps, curb, gutter, sidewalks, and pavement shall be removed (including saw cutting) as directed by the Engineer, and legally disposed of by the Contractor. None of the above pay items shall be removed until measured in place by the Engineer.
- G. Private Driveways: The Contractor shall keep private driveways open and unobstructed as far as practicable and shall regrade same from curb to property line when directed by the Engineer.

END OF SECTION 00425

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SECTION 00450 - SECTION 00450 PLANT MIX BITUMINOUS CONCRETE SURFACE COURSE
AND BITUMINOUS CONCRETE BASE COURSE Revision Date October 12, 2021
Town of Burgaw Specifications

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered by this section consists of the production, delivery, placement and compaction of all types of bituminous plant mixed bases and surface courses.

1.2 REFERENCES

- A. P The "Standard Specification for Roads and Structures" current edition and any revisions by the North Carolina Department of Transportation (NCDOT) will govern in its entirety the work under these specifications except as they are modified hereinafter.
- B. Bituminous Plants Production: All bituminous plants shall meet specification 610 of the Standard Specifications of Roads and Structures current edition and any revisions by the NCDOT. All bituminous plants that produce bituminous mixes that are to be used within the rights-of-way of the Town of Burgaw, or on any new street that is to be accepted by the Town of Burgaw, shall have a current and up to date certification of the asphalt plant on file with the Town of Burgaw.
 - 1. Any bituminous mix that is produced by a plant that does not have NCDOT certification is unacceptable for use within the Town of Burgaw.
- C. Quality Management System for Asphalt Pavements: The Contractor shall produce and construct asphalt mixtures and pavements in accordance with a quality management system as described in Section 609 of the NCDOT Standard Specifications. The Contractor shall submit only NCDOT approved mix design and must be approved by the Engineer prior to delivery. Apply these specifications to all materials and work performed in accordance with Division 6 of the NCDOT Standard Specifications. Perform all quality control activities in accordance with NCDOT "Hot Mix Asphalt Quality Management System (HMA/QMS)" Manual.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Weather and Temperature Limitations: This section addresses air temperature, road surface temperatures, seasonal limitations, weather requirements, the layer thickness that apply when producing and/or placing the various mixture types. Bituminous mixtures shall not be produced or placed during rainy weather, when the sub-grade or base course is frozen, nor when the moisture on the surface to be paved would prevent proper bond. Bituminous material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the following temperatures:

TEMPATURE OF LAYER BEING PLACED

Material Type	Minimum Air	Minimum Road Temperature	Surface Temperature
ACBC, Types B 25.0C, B 37.5 C, PADC		35 degree F (2 degree C)	35 degree F (2 degree C)
ACIC, Types I 19.0C		35 degree F (2 degree C)	35 degree F (2 degree C)
ACSC, Types S 4.75A, SF 9.5B		40 degree F (5 degree C)	40 degree F (5 degree C)
ACSC, Types S 9.5C		40 degree F (5 degree C)	40 degree F (5 degree C)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Composition of Mixtures (Job Mix Formula): All bituminous plant mixes that shall be used within the rights-of-way of the Town of Burgaw shall be produced in a NCDOT certified bituminous plant.
- B. All bituminous base courses and surface course mixes that are to be use within the rights-of-way of the Town of Burgaw shall be NCDOT approved and have all job mix formulas on file with the Town of Burgaw. No other bituminous mixes will be acceptable. Must submit mix design for the project.
- C. All binder shall meet the appropriate requirements of Section 610 of the NCDOT Standard Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Construction Requirement: The production, spreading, finishing, weather limitation, joints, compaction, density and surface requirements shall be in accordance with the Standard Specifications for Roads and Structures current edition and any revisions by the NCDOT.
- B. Transportation of Bituminous Mixture: The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been sprayed with a lime solution, a soap and oil solution, or other approved material, to prevent the mixture from adhering to the beds. Fuel oil is not permitted for this purpose. Truck beds shall be drained prior to loading. Each load of mixture shall be fully covered with a canvas or other suitable material. All covers shall be so constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8 inch diameter hole shall be provided on each side of the vehicle body near the center of the body and 6 inches above the bed of the vehicle for the purpose of inserting a thermometer.
- C. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15 degrees F to minus 25 degrees F of the specified job mix temperature.

TABLE 610-1 MIXING TEMPERATURE AT THE ASPHALT PLANT	
Binder Grade	JMF Temperature
PG 64-22	300°F
PG 70-22	315°F
PG 76-22	335°F

- D. The contractor is required to have a certified Roadway Technician with each paving operation at all times. This person is responsible for monitoring all roadway paving operations and directly supervising all quality control processes and activities. Provide a certified nuclear gauge operator when nuclear density control is being used. Provide the Town of Burgaw with an organizational chart, including names, telephone numbers, and current certification numbers of all personnel responsible for the quality control program while asphalt paving work is in progress.

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- E. Utilize the 30 foot minimum length mobile grade system to control longitudinal profile when placing the initial lanes and all adjacent lanes of all courses, including resurfacing, leveling courses, and asphalt in-lays, unless otherwise approved by the Engineer. Where public traffic is being maintained, apply only as much tack coat as can be covered during the same day's operation. In addition, the Engineer may limit the application of tack coat in advance of the paving operation depending on traffic conditions, project location, proximity to business or residential areas, or other reasons. In the event that tack coat material is not covered in the same day's operation, the Engineer may require the application of suitable granular material or other means to provide a safe traffic condition at no additional cost to the Town of Burgaw. The contractor will be responsible for any clean-up of the materials that was placed at no cost to the Town of Burgaw.
- F. Contractor will furnish with each load of asphalt a scale ticket by a certified weigh master showing the amount of asphalt on the truck. Contractor will be paid on a unit price per ton of asphalt that is actually placed and rolled to a finish asphalt surface or base course.
- G. The Engineer may prohibit or restrict the use of vibratory rollers where damage to the pavement being placed, the underlying pavement structure, drainage structures, utilities, or other facilities is likely to occur or is evident.
- H. The final surface course material shall be compacted using two steel-wheel rollers and a pneumatic tired roller. For any paving operations, two rollers required on site.
 - 1. Initial rolling shall be achieved using an 8 to 10 ton steel wheel roller.
 - 2. Intermediate rolling shall be achieved using a pneumatic tired roller.Final rolling shall be achieved using an additional steel wheel roller. I. Surface Smoothness:
 - 1. Base Course – 1/4" in 10 feet.
 - 2. Surface Course – 1/8" between any two contact points, 10-foot straight edge.

END OF SECTION 00450

SECTION 00490 - PRECAST DRAINAGE STRUCTURES Revision Date October 12, 2021
Town of Burgaw Specifications

PART 1 - GENERAL

1.1 SECTION INCLUDES

1. The work covered by this section includes round and rectangular pre-cast concrete drainage structures including inlet structure components, sub-grade structure components, grates, covers and accessories.
2. The Contractor shall build inverts in all drainage structures in accordance with NCDOT standards as noted on the details.

1.2 REFERENCES

1. Pre-stressed Concrete Institute: Manual for Quality Control for Plants and Production of Pre-cast and Pre-stressed Concrete Products.
2. National Pre-cast Concrete Association: Quality Control Manual for Pre-cast Concrete Plants.
3. American Society for Testing and Materials:
 - 1) ASTM C478: Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 2) ASTM C890: Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Pre-cast Concrete Water and Wastewater Structures.
 - 3) ASTM C891: Standard Practice for Installation of Underground Pre-cast Concrete Utility Structures.
 - 4) ASTM C913: Standard Specification for Pre-cast Concrete Water and Wastewater Structures.
4. American Association of State Highway and Transportation Officials Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets (AASHTO M198).
5. American Concrete Institute: Building Code Requirements for Reinforced Concrete (ACI 318).
6. Occupational Safety and Health Administration: Standard 1926.704, Requirements for Precast Concrete.

1.3 SUBMITTALS

1. The following information must be submitted to the project Engineer:
 - 1) Schedule of the drainage structure components to be provided on the project including the following:
 - a) Sheet number where the structure plan and profile are shown.
 - b) Line number when applicable.
 - c) Drainage structure number or station number.
 - d) Invert elevation of the influent and effluent lines as shown on the plans.

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- e) Inlet structure flow-line elevation as shown on the plans.
 - f) Total height required from top of base slab to top of structure.
 - g) Total height of the individual and assembled drainage structure components.
 - h) Top and bottom elevation of the drainage structure as calculated.
 - i) Manufacturer's part or catalog number and number required of each component.
 - j) Each pipe size, type and hole size and its distance from top of base slab.
 - k) Pipe location in degrees clockwise from step centerline on round structures.
 - l)
 - m) Pipe location on rectangular structures by wall and intersecting angle relative to wall.
 - n) Minimum round inside diameter or rectangular inside dimensions required.
2. Detail of each pre-cast concrete component to be provided, sealed by the registered Professional Engineer including the following:
 - a) Manufacturer's part number or catalog number.
 - b) Inside diameter or dimensions and lay length.
 - c) Wall thickness and base or top thickness where applicable.
 - d) Handling weight and lift hole or insert or loop description and location.
 - e) Wire size, spacing and area provided per vertical foot (when applicable).
 - f) Reinforcing bar size and spacing or location.
 - g) Design loads for all rectangular components and round top slab components.
 - h) Step locations on round structures.
 - i) Concrete design strength and manufacturer's mix number.
 - j) Height, width, slope and annular space of the tongue and groove for products requiring tongue and groove joints.
 3. Step detail and material specifications.
 4. Joint material detail, material specifications and calculations showing that the joint material cross section is greater than the joint's annular space times its height.
 5. Lifting device and hole detail including design loads.
 6. At the request of the Engineer or owner, submit the following:
 - 1) Structural analysis and design calculations for precast rectangular components and round top slab components, performed in accordance with applicable codes and standards, showing that allowable stresses will not be exceeded. All calculations must be sealed by a Registered Professional Engineer.

- 2) Calculations or test results verifying that the lifting device components and holes are designed in accordance with OSHA Standard 1926.704.
- 3) Concrete 28 day compression strength results for every day production of Pre- cast Components for the project was performed, showing the required strength according to the guidelines established in ACI 318.
- 4) Reinforcing and cement mill reports for materials used in the manufacture of Pre- cast Components for this project.
- 5) The above test reports for similar Pre-cast Components recently produced, submitted prior to production of Pre-cast Components for this project.

1.4 QUALIFICATIONS

- A. The pre-cast manufacturer shall comply with the following requirement:
 1. The Precast Manufacturer shall be a NCDOT approved manufacturer of precast concrete structures and have a minimum of 5 years of experience in manufacturing the required components.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete shall conform to ASTM C478, C858 and as follows:
 1. Compressive strength: 4000 psi minimum at 28 days.
 2. Air Content: 6% + 1.5%.
 3. Cementitious Materials: Minimum of 564 pounds per cylinder yard.
 4. Course Aggregates: ASTM C33, bound, crushed, angular granitic stone only.
 5. Fine Aggregates: ASTM C33 free from organic impurities.
 6. Chemical Admixtures: ASTM C494 calcium chloride or admixtures containing calcium chloride shall not be used.
 7. Air Entraining Admixtures: ASTM C260.
- B. Reinforcing steel shall be ASTM A615 Grade 60 deformed bar, ASTM A82 wire or ASTM A185 welded wire fabric.
- C. Lift Loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars shall not be allowed.
- D. Flexible joint sealants shall be butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1 percent volatile matter and suitable for application temperatures between 10 and 100 degrees F.
- E. Epoxy gels shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

2.2 COMPONENTS

- A. P Pre-cast Components shall be designed and manufactured as described in this paragraph and in the following paragraphs for the specific components.

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1. Lifting Inserts, Holes and Devices shall comply with OSHA Standard 1926.704. Lift holes and inserts shall be sized for a precision fit with the lift devices. Lifting devices shall be provided by the Pre-cast Manufacturer.
 2. Joints shall be sealed internally between the tongue and groove and additionally around the external perimeter of the joint as follows:
 - a. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than 1/16 inch thick and 6 inches wide applied to the outside perimeter of the joint.
 - b. Internal Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 14 feet long and having a cross-sectional area no less than the annular space times the height of the joint
 - c. At the option of the Contractor, Internal Seals on round joints may consist of an ORing Gasket conforming to ASTM C443, installed according to the Pre- cast manufacturer's recommendation.
 3. Rings, Covers, Grates, and Frames shall be Class 30 gray cast iron and shall be designed for 16,000 pound wheel loads when located in roadways.
 4. Pre-cast Base Sections shall be cast monolithically without construction joints or with approved galvanized or PVC water-stop cast in the cold joint between the base slab and the walls. The minimum size of the base section shall be as specified in the schedules.
 5. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable. Form ties through the wall are not allowed. Exterior slab surfaces below grade shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be as set forth in the appropriate References. Exposed Drainage Structure Top Components shall have a form finish or a light broom finish on their exposed surfaces. Fins, voids, chips, or fractures over 3/8 inch in diameter shall be filled with thin cement paste and finished to a color and texture reasonably consistent with that of formed finish. Rings and covers cast in exposed tops shall be free from cement paste build up.
 6. Provisions for pipe entrances in the structures shall be cast or cored openings.
 - a. Pipe openings in round structures shall remain 6 inches clear of other pipe openings.
 - b. Pipe openings in rectangular structures shall not extend into the corners and may extend across a joint only when structural analysis shows stresses to be within the allowable.
 7. Components shall be designed in accordance with ACI, ASTM C890 and following loads:
 - a. Horizontal Load on Walls: An earth load of 80 psf per foot of burial depth plus a live lateral surcharge due to HS20 traffic loads of 80 psf.
 - b. Vertical Load on Below Grade Adapter Slabs and Tops: An earth load of 120 psf per foot of overburden plus a live HS20 traffic load.
 - c. Vertical Load on Exposed Inlet tops: A live 300 psf load.
 - d. Vertical Load on Cast Iron Covers and Grates Supported Around Perimeter: A live HS20 load.
- B. Round Sub-grade Components shall be designed and manufactured in conformance with ASTM C478 and as follows:

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1. Riser Sections shall have a minimum lay length of 16 inches.
 2. Pre-cast Concentric and Eccentric Cone Sections shall have an inside diameter at the top of 24 inches. The width of the top ledge shall be no less than the wall thickness required for the cone section.
 3. Pre-cast Transition Cone or Top Sections may be used to provide an eccentric transition from 60 inch and larger structures to 48 inch diameter risers, cones, and adaptor slabs. Transition tops shall only be used in areas not subject to vehicle traffic with no more than 20 feet of cover.
 4. Provide Steps in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on 16 inch centers when 42" deep or greater. Secure steps to the wall with a compression fit in cast or drilled holes or cast in place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½ inch diameter grade 60 bar and have serrated tread and tall end lugs. Pullout strength shall be a minimum of 2,000 pounds when tested according to ASTM C497.
 5. Joints of Bases, Risers and Cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361.
- C. Rectangular Sub-grade Components shall be no less than 22 inches wide, 34 inches long, designed and manufactured in conformance with ASTM C913 and as follows:
1. Riser sections shall not be allowed on boxes smaller than 4 feet long by 4 feet wide.
 2. Pre-cast Transition Top Sections may be used to provide an eccentric transition from 4 foot by 4 foot and larger storm drain structures to 48-inch diameter risers, cones and adapter slabs. The maximum amount of fill over the transition top section shall be 20 feet.
 3. Joints between precast components shall be keyways or tongue and groove. Joints to accept cast iron frames shall be flat and no less than 5" wide.
- D. (Access Manhole) Inlet Components shall have cast iron rings and covers shall be as shown in the details with an opening diameter of 22 inches. Adapter slabs and cones shall have a minimum opening diameter of 24 inches. Precast grade rings conforming to ASTM C478, with a minimum lay length of 4 inches and totaling no more than 12 inches in height shall be used to adjust rings and covers to finished grade.

2.3 CONFIGURATION

- A. Construct (Access Manhole) Structures to the elevations shown on the plans and as follows:
1. A 24-inch diameter Cast Iron Ring and Cover
 2. A Concentric or Eccentric Cone or an Adapter Slab and a Round or Rectangular Subgrade Structure sized according to the schedule.
- B. Drainage Structures greater than 8 feet deep shall be no less than 48 inches in diameter or 48 inches wide by 48 inches long.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Product Delivery, Storage and Handling: Coordinate delivery with the manufacturer, handle and store the Precast Components in accordance with ASTM C891 and the manufacturer's

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recommendations using methods that will prevent damage to the components and the joint surfaces.

3.2 PLACING PRECAST CONCRETE SECTION

1. P Excavate to the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6" beyond the precast base and follow ASTM C891 excavation standards.
2. Set base plumb and level, aligning pipe opening with pipe invert.
3. Thoroughly clean joint tongue and grooves to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against bottom groove. Leave protective wrapper attached until sealant is entirely unrolled against groove. Do not stretch. Overlap from side to side not top to bottom.
4. Set risers and tops, aligning internal wall surfaces, so that proper alignment is achieved, taking particular care to clean, prepare and seal joints.
5. When recommended by the manufacturer, fill the void between horizontal joint surfaces with a sand cement grout around the outside perimeter as risers are set.
6. After joining precast sections, apply the butyl sealant sheet around the outside perimeter of the joints below grade.
7. Secure Pipe Connectors to Pipe according to the Connector Manufacturer Instructions. When pipe stub outs are installed, provide restraint from longitudinal movement before backfill.
8. Lift Holes leaving less than 2" of wall thickness shall be plugged from the outside using a sand cement mortar and then covered with butyl sealant sheet. Lift Holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8" thick extending 2" beyond the penetration.
9. Perform the final finishing to the Structure interior by filling all chips or fractures greater than 1/2" in length, width or depth and depressions more than 1/2" deep in inverts with a sand cement mortar. Clean the interior of the Structure, removing all dirt, spills or other foreign matter.

3.3 SCHEDULES

A. Round Storm Drain Structures

1. Provide round sub-grade structures with minimum inside diameters in inches based on the pipe's outside diameter and the angle formed with the adjacent entering pipe as shown in the table below:

Largest Pipe OD	Minimum Degrees Between Pipe Entering Structure										
	180	165	150	135	120	105	90	75	60	45	30
15	48	48	48	48	48	48	48	48	48	72	96
21	48	48	48	48	48	48	48	60	60	84	120
27	48	48	48	48	48	48	60	60	72	96	N/A
33	48	48	48	48	48	60	60	72	84	120	N/A
39	48	48	48	60	60	60	72	84	96	N/A	N/A
45	60	60	60	60	72	72	84	96	108	N/A	N/A
51	72	72	72	72	72	84	84	108	120	N/A	N/A
57	72	72	72	72	84	84	96	108	N/A	N/A	N/A
63	84	84	84	84	84	96	108	120	N/A	N/A	N/A

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69	84	84	84	84	96	108	120	N/A	N/A	N/A	N/A
75	96	96	96	96	96	108	120	N/A	N/A	N/A	N/A
81	96	96	96	96	108	120	N/A	N/A	N/A	N/A	N/A

2. Structures with smaller inside diameters may be supplied when pipes are of different diameters and calculations or shop drawings show that a minimum of 6 inches clearance will be maintained between pipe openings.
3. The minimum lay length of the base section shall be no less than the diameter of the pipe opening for pipe OD up to 87 inches. B. Rectangular Storm Drain Structures.
4. Provide rectangular sub-grade structures with minimum inside wall widths based on the entering pipe's outside diameter and the angle formed with the penetrated wall as shown in the chart below:

Largest Pipe OD	Minimum Degrees Between Pipe and Wall						
	90	80	70	60	50	40	30
15	22	22	22	22	22	34	34
21	22	22	22	34	34	34	46
27	34	34	34	34	46	46	58
33	34	34	46	46	46	58	70
39	46	46	46	46	58	70	82
45	46	46	58	58	70	70	94
51	58	58	58	70	70	82	106
57	58	58	70	70	82	94	118
63	70	70	70	82	82	106	130
69	70	70	82	82	94	118	142
75	82	82	82	94	106	118	154
81	82	82	94	94	106	130	166
87	94	94	94	106	118	142	178

5. Structures with narrower walls may be supplied when pipes are different diameters than shown and calculations of shop drawings show that the pipe will not penetrate the corners of the structure.

END OF SECTION 00490

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SECTION 02713 - WATER MAINS Revision Date October 12, 2021
Town of Burgaw Specifications

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work under this section consists of furnishing all plant, labor, materials, and equipment for the installation of water mains, valves, fire hydrants, fittings, and appurtenances.

1.2 QUALITY ASSURANCE

A. STANDARDS

1. P American National Standards Institute
 - a. ANSI A21.10 ductile cast iron fittings
 - b. ANSI A21.11 ductile cast iron fittings
 - c. ANSI 21.4 ductile cast iron pipe cement lining
 - d. ANSI A21.51 ductile cast iron pipe
 - e. ANSI A21.6 ductile cast iron pipe dimensions
 - f. ANSI A21.8 ductile cast iron pipe dimensions
 - g. ANSI B16.1 ductile cast iron fittings
 - h. ANSI B16.b ductile cast iron fittings
2. American Society for Testing and Materials
 - a. ASTM A48 cast iron butterfly valve body
 - b. ASTM A126 cast iron butterfly valve body
 - c. ASTM A252 encasement pipe
 - d. ASTM A339 ductile cast iron fittings
 - e. ASTM A436 cast iron butterfly valve disc
 - f. ASTM C33 crushed stone
 - g. ASTM D1598 pipe tests
 - h. ASTM D1599 pipe tests
 - i. ASTM D1784 PVC pipe
 - j. ASTM D2152 pipe tests
 - k. ASTM D2241 PVC pipe
3. American Water Work Association
 - a. AWWA C110 cast iron fittings
 - b. AWWA C111 cast iron fittings
 - c. AWWA C151 ductile cast iron pipe
 - d. AWWA C301 pipe gaskets
 - e. AWWA C500 gate valves
 - f. AWWA C502 fire hydrants
 - g. AWWA C504 butterfly valves

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- h. AWWA C509 gate valves
 - i. AWWA C600 pipe installation
 - j. AWWA C900 PVC pipe
 - 4. American Association of State Highway Transportation Officials
 - a. AASHTO T99 compaction of backfill
 - b. ASTM 698 Soil Density
 - 5. Federal Specification
 - a. WW-P-42 IB
 - b. WW-P-421C ductile cast iron pipe joints
 - c. WW-P-4211 pipe gaskets
- B. Soil Testing
 - 1. The Owner shall retain the services of a testing laboratory to perform all density tests required at the project site. In areas of fill and back fill, field density tests shall be performed in sufficient numbers to insure that the specified density is obtained. These tests shall be performed at no cost to the Contractor with the following exceptions:
 - a. The costs of any tests or investigations which result in the identification of defective work or material or improper placement or compaction shall be borne by the Contractor.
 - b. The Contractor shall be responsible for the cost of testing borrow material which shall include standard density tests (Proctor curves).
 - c. All defective work or material shall be repaired and/or replaced by the Contractor at no cost to the Owner. Areas in which testing indicates compaction below the specified density shall be reworked, or removed and replaced by the Contractor, at no expense to the Owner, until specified compaction is obtained.
- C. Soil Erosion Control
 - 1. Siltation, sedimentation, and erosion shall be kept to a minimum at all times during construction. Sedimentation and erosion control methods shall be employed by the Contractor during construction in order to comply with the requirements of the N.C. Sedimentation Pollution Control Act of 1973, and to plan requirements.
- D. Material Testing
 - 1. Material shall be tested in accordance with the General Conditions of these Specifications and the following:
 - a. Pipe: Each joint of pipe shall be subjected to successfully meet a hydrostatic proof test in accordance with AWWA requirements for each type. Cast iron pipe shall be tested prior to lining. Certified test results shall be furnished to the Engineer, for each shipment of pipe.
 - b. PVC Pipe: PVC pipe shall be given the Quick Burst Test in accordance with ASTM D1599; Sustained Pressure Test in accordance with ASTM D1598; Acetone Immersion Test in accordance with ASTM D2152; Vise Flattening Test (compress 2" long ring in less than 1 minute to 100% flattening without evidence of splitting or shattering); and Drop Impact Test C. (Single impact load from a free-falling missile having a 2" diameter rounded, 1" long nose compacted on a 6" long horizontal specimen. No shattering or splitting shall occur at the following energies 12" nominal size - 24 ft-lb, 2" - 57 ft-lb, 4" - 86 ft-lb, and 6" 100 ft-lb).

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- c. Pipe Fittings: Pipe fittings shall be subject to inspection and testing in accordance with standard manufacturing practice.
- d. Gaskets: Gaskets shall be tested, if required, in accordance with Section 3-4 of AWWA C301, and ANSI A21.11.
- e. Valves: Valves shall be tested to double the design working pressure and test results submitted to the Engineer upon request.
- f. Other Material: Other material shall be subject to such testing as the Engineer may require should its acceptability be questioned.
- g. System Testing:
 - 1) Pressure Test
 - a) After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 150% the working pressure at the point of testing or 150 psi whichever is greater.
 - b) Test Pressure Restrictions: Test pressures shall be:
 - Not be less than 125% the working pressure or 125 psi whichever is greater at the highest point along the test section.
 - Not exceed pipe or thrust restraint design pressures.
 - Be of at least 2-hour duration.
 - Not vary by more than plus or minus 5 psi.
 - Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
 - Not exceed the rated pressure of the valves if resilient-seated butterfly valves are used.
 - c) Pressurization: Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.
 - d) Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Engineer.
 - e) Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the Engineer.

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- 2) Leakage Test: A leakage test shall be conducted concurrently with the pressure test.
- a) Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
 - b) Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:
$$L = 7400 \frac{ND(P)^{1/2}}{L}$$

L - the allowable leakage in gallons per hour
N - the number of joints in the length of pipeline tested
D - the nominal diameter of the pipe, in inches
P - the average test pressure during the leakage test, in pounds per square inch gauge
 - c) When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
 - d) When hydrants are in the test section, the test shall be made against the hydrant.
 - e) Acceptance of Installation: Acceptance shall be determined on the basis of allowable leakage. If Any test of pipe laid discloses leakage greater than that specified by the leakage test requirements of this Section, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.
 - f) All visible leaks are to be repaired regardless of the amount of leakage.
 - g) Should any test disclose leakage greater than that allowed above, the Contractor shall, at his own expense, locate and repair the defect until the leakage is within the specified allowance.
 - h) The Contractor shall perform the above testing to his satisfaction for acceptance before having Engineer present for verification and retesting. All assemblies for testing at time of Engineer's witnessing of test shall be broken down and reconnected.
 - i)
- 3) Sterilization:
- a) Before any potable water main is placed in service, it shall be flushed out and sterilized with chlorine or calcium hypochlorite. The sterilizing solution shall be introduced at one end of the main as water is being withdrawn from the other end, in such proportion as to give

50 ppm of free chlorine throughout the main. The solution shall remain in the pipe for 24 hours, at which time it shall have a residual chlorine of 10 ppm throughout the main, or the process shall be repeated. The line shall be flushed out and bacterial analyses shall show negative results, if necessary, the process shall be repeated. Chemicals required shall be furnished by the Contractor.

- b) Upon completion of sterilization, the water line shall be refilled with water and the Contractor shall collect samples for bacteriological examination. Generally, a sample will be taken every 2,000' for distribution lines and every 4,000' on transmission lines. Samples may be taken at new service connections, at air valve stations, or through any other connection to the line 1" or smaller in diameter. Samples shall not be taken at fire hydrants without the expressed consent of the Engineer. The samples shall be taken in standard sterilized bacteria sample bottles marked with the project name and sample location, samples shall be delivered to the State Board of Health Laboratory for analysis. Results of the analysis shall be furnished to the Engineer.
- 4) Submittals:
- a) Shop drawings shall be submitted to the Engineer in accordance with the General Conditions for the following items:
 - Valves
 - Curb Stops
 - Corporation Stops
 - Valve Boxes
 - Fire Hydrants
 - Tapping Sleeves and Valves
 - Transition Couplings
 - Water Meter Boxes
 - Service Meter Yoke
 - Service Tapping Saddle
 - b) Manufacturer's certifications shall be submitted to the Engineer certifying that the following materials meet all requirements of the specifications:
 - Water main pipe
 - Water main fittings
 - Water service line
 - Water service line fittings
 - c) Mix designs for concrete and asphalt shall be submitted to the Engineer for approval if requested by the Engineer.
 - d) Six (6) copies of all submittals are required. None of the above listed equipment or materials shall be used on the project unless the necessary approval for that particular item has been given by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS:

1. Where material and product specifications are shown on the drawings, the Owner's standard details shall be met. Where materials and specifications are not shown on the drawings the requirements of this section shall govern.
2. All materials and appurtenances shall meet the following minimum standard requirements therefore. It shall be each manufacturer's responsibility to check the proposed installation and to furnish material that will be fully capable of performing its intended function.
3. Pipe shall be of the type, size, class and diameter as hereinafter specified and called for by the Plans and/or Bid. General Design considerations shall comply with all applicable AWWA Standards at each type and to the following:
4. Trench width for buried pipe design shall be considered as the outside diameter of the pipe plus 2', from the bottom and up to 1" above the top of the pipe.
5. Buried pipe shall be designed for laying condition "C" (flat bottom trench- tamped backfill) to withstand all internal pressures and external loads with a minimum depth of cover of 3', for pipelines 8" and smaller in diameter, and 3'-6" for lines 10" and larger in diameter, and greater depths of cover where required by the Plans, plus an H-20 live load in accordance with A.A.S.H.T.O. Specifications.
6. Design pressure shall consist of 150 psi working pressure plus 100 psi surge allowance unless noted differently on the Plans.
7. Pipe diameters shown or called for shall be the minimum net inside diameter of the pipe after any required lining is placed, with a maximum tolerance of 3" on minus side, for sizes through 36" diameter.
8. Pipe fittings shall be of the size, configuration and type called for in the Plans. All fittings shall be of at least the same class as the pipe with which they are used. Ductile or gray cast iron fittings shall be used with all ductile and gray cast iron pipe, asbestos cement pipe, and PVC pipe (4" or larger in diameter).
9. Valves shall be of the type, size and class required by the Plans and all valves shall have standard mechanical joint ends, except where flanged or other type ends are specifically required. Flanges, where required shall be 125 lb. ANSI standard unless otherwise indicated. All valves shall be furnished with operating nuts, or handwheels as necessary, except in instances where other operating devices are specified or shown. All valves shall be of at least the same class of the pipe with which they are used. A cast iron valve box and cast iron cover marked "WATER" shall be provided for each underground valve except where shown differently on the Plans. Cast iron rings and covers shall be provided for all air valves and concrete vaults as detailed on Plans.

2.2 DUCTILE CAST IRON PIPE

- A. P Ductile cast iron pipe shall be centrifugally cast of ductile cast iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum elongation of 10% (Grade 60-42-10). It shall be designed, manufactured, and shall conform to the requirements of ANSI A21.50 and A21.51, for a minimum 150 psi operating pressure plus a minimum allowance of 100 psi for surge.

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- B. Nominal laying lengths shall be 18' or 20' nominal maximum of 20% of each size for each order being as much as 24" shorter than the nominal laying length and an additional 10% as much as 6" shorter than nominal laying length.
- C. Pipe joints shall be either Type II or Type III in accordance with Federal Specification WW-P-42 IC except where flanged ends are specifically required by Plans.
- D. Dimensions shall conform to the requirements of ANSI LA21.6, ANSI A211.8, ANSI A21.11, and WW-P-42 IC, as applicable. Dimensions shall be gauged at sufficiently frequent intervals to assure dimensional control. Insides of sockets and outside of spigot ends shall be tested with circular gauges.
- E. Minimum nominal wall thicknesses and allowable depths of cover shall be as follows:

Maximum Depth Cover	Pipe Diameter (inches)									
	4	6	8	10	12	14	16	20	24	30
5	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.30
8	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.39
12	0.26	0.25	0.27	0.29	0.31	0.33	0.34	0.39	0.44	0.44
16	0.26	0.25	0.27	0.29	0.31	0.36	0.37	0.42	0.50	0.51

Ductile iron pipe shall be minimum Class 50.

- F. Tolerances below the standard thickness of pipe and bell shall not exceed:

Size	Allow. Minus Tolerances (inches)
4-8	0.05
10-12	0.06
14-12	0.07

- G. All pipe shall be tested at the factory in accordance with AWWA requirements for each type.
- H. Underground pipe shall be coated on the outside with asphaltic coating per ANSI A21.51. The coating shall be continuous, smooth, strongly adherent to the pipe and shall not become brittle from cold nor sticky from the heat.
- I. Interior surfaces of each pipe, for water service, shall be cement lined in accordance with ANSI, 21.4, with minimum thickness of 1/16" for 3" to 12" pipe and 3/32" for 14" to 24" pipe, and 1/8" for 30" to 48" pipe.
- J. Each pipe shall be weighed prior to placing of the inside lining. Weight, nominal thickness, sampling period, and class of pipe shall be shown on each pipe. The manufacturer's year of production and the letters DI or Ductile shall also be cast or stamped on the pipe. All markings shall be clear and legible and on, or near, the bell end.

2.3 POLYVINYL CHLORIDE PIPE

- A. PVC pipe shall be rigid polyvinyl chloride with integrally formed, factory fabricated for rubber ring type joints. It shall be suitable for all conditions imposed by Plan locations and for a minimum working pressure of 150 psi, plus 100 psi surge allowance at 73°F. Pipe shall be Type 1, Grade 1, made from clear virgin material and shall conform to all requirements of AWWA Specifications C-900, Class 150. All pipe shall bear the manufacturer's name, specification, and class of pipe. Each length of pipe shall be 20' "1", or 38' "1" except that, random lengths may be furnished for special connections and other special uses.

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- B. Provisions must be made for expansion and contraction at each joint, through the rubber gasket and pipe bell. Laying lengths shall be 20'-1", or 38'-1" except that, random lengths may be furnished for special connections and other special uses.

2.4 RESTRAINED JOINT PIPE AND FITTINGS

- A. Restrained joint pipe and fittings shall be ductile iron manufactured in accordance with AWWA C151 and C153. The restraining method shall be by a snap in place flexing restraining ring at the joint. The pipe and fittings shall be American Flex- Ring, Griffin Snap-Lok, US Pipe, T.R. Flex, or equal.

2.5 STEEL ENCASEMENT PIPE

- A. Steel encasement pipe shall be bituminous coated inside and outside. Bituminous coating shall be 6 mil. minimum thickness. Steel encasement pipe shall have a minimum thickness as indicated in the plans for bores under highways and shall meet ASTM Specifications A252 with a minimum yield strength of 35,000 psi.

2.6 DUCTILE CAST IRON FITTINGS

- A. Ductile cast iron fittings shall conform to the requirements to ANSI Specification A21.10, with mechanical joint ends conforming to ANSI Specification A21.11, except that material and manufacturer shall conform to ASTM Specification A339, Grade 80-60-3 and compact fittings shall conform to ANSI/AWWA C 153/A21.53. All fittings shall be bituminous coated and cement lined as required for pipe. Where flanged ends may be required, flanges shall conform to applicable requirements of ANSI B16.1 and ANSI B16b. Minimum class shall be equal to class pipe used.

2.7 PVC FITTINGS

- A. PVC fittings and adapters shall conform to the same requirements as for pipe and shall be the same class as the pipe.

2.8 TAPPING SLEEVES AND SADDLES

- A. Tapping sleeves shall be mechanical joints or caulked type with 125 lb. ANSI Standard outlet flange, suitable for 150 psi. Tapping Saddles shall be banded type, with two (2) bands for ductile iron pipe and hinged type for PVC pipe, suitable for bolting in place on the pipe to be tapped. Sleeve shall have a single rubber gasket cemented in place on the inside of the sleeve body. Sleeve shall meet all the requirements of ANSI/AWWA C110/A21.10 and C111/A21.1.

2.9 JOINT MATERIAL

- A. Gaskets for pipe and fittings shall be continuous ring of rubber material compounded to resist deterioration and of a texture to assure a permanent and watertight seal. They shall have smooth surfaces, free from pitting, blisters, porosity or any other defects. Gaskets shall conform to the requirements of AWWA Specification C301 and Federal Specification WW-P4211.
- B. Gasket lubricant shall be a potable hydrogenated vegetable oil, insoluble in cold water, non-toxic, shall not support the growth of bacteria, and shall not impart taste nor odor to the water. It shall not contain detergents soaps, organic solvents or other deleterious ingredients and shall have no deterioration effects on the gaskets. The lubricant shall be semi-paste, easily applicable, readily adherent to the inside of the bell and shall remain in a usable state throughout the range

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of temperature in which pipe is normally installed. Lubricant shall be delivered to the job site in unopened containers bearing the manufacturer's name and trade name or trademark.

2.10 GATE VALVES

- A. Gate valves shall be iron body or resilient seat, non-rising stem and provided with suitable stem seals. They shall comply with AWWA C509, and be designed for an operating pressure of 150 psi. All valves shall open left (counter clockwise). Buried valves shall have a 2" square operating rest. Extension stems shall be furnished where depth of bury places operating nut in excess of 4' below finished grade. No extra compensation for extension stem will be forthcoming.
- B. Sixteen inch (16") valves and larger shall be equipped with bevel gear operator and bypass line with valve. The bypass line and valve shall be 3" diameter for valves under 24" and 4" diameter for valves 24" and larger. The gear mechanism shall be totally enclosed with watertight gear case, suitable for underground installation. The valves shall be designed for installation in a horizontal position and shall be equipped with track, scrappers, and rollers or trunions. Valve interior coating shall be the industry standard unless otherwise specified. Buried valves shall be bituminous or asphalt coated as specified above in item 1-2B. Valves for non-buried service shall have the exterior prime coated only. Gate valves shall be as manufactured by Clow or approved equal.

2.11 PRESSURE AIR VALVES

- A. Valve interior and exterior coatings shall be the industry standard unless otherwise specified. Pressure air valves shall be either Crispin Pressure Air Valves, as made by Multiplex Manufacturing Company, or APCO valves as made by Valve and Primer Corporation, or valves of equal characteristics approved by the Engineer. The valves may be compact in size and shall be designed for at least 150 psi pressure. Vaults to house Pressure Air Valves shall be concrete and of the design and dimensions as detailed on the plans or as approved otherwise.

2.12 FIRE HYDRANTS

- A. Fire hydrants shall be of the compression type, dry top, traffic model of cast iron and shall conform to the requirements of AWWA C502. They shall have 6" mechanical joint connections with a minimum 4½" main valve or larger if required by manufacturer to meet the flow and loss requirements of AWWA C502. Connection of valve seat to drain ring shall be bronze-to-bronze threads. Each hydrant shall have two 2½" hose nozzles and one 4½" pumper nozzle, with washers. Barrel lengths shall be generally for 3½' trench, except where other lengths are necessitated by the hydrant location. The threads, operating nuts and direction of opening shall be identical to that of existing hydrants on the system. It shall be the Contractor's and Manufacturer's responsibility to insure that threads, nuts, and direction of opening match existing types or are of the types desired by the Owner.
- B. The hydrant barrel shall be made in two sections joined together a few inches above the ground line by a watertight coupling, or break ring, so designed that if a break occurs, it will occur at this point. Breakaway bolts are not acceptable. The ring shall be of ample strength for ordinary service, and be easily and cheaply replaceable. The valve stem shall be in two sections, joined by a special coupling at the same point as the break ring, so designed that if the hydrant is broken, the coupling will break and the valve not be disturbed. All working parts shall be removable without disconnecting the hydrant. Fire hydrants shall be as manufactured by Clow or approved equal.

- C. Fire hydrants shall be painted with a reflective two-tone color scheme with colors as selected by the Owner. The hydrants shall be cleaned, primed, and painted with a minimum of a two-coat system. The fire hydrant top and all caps shall receive the reflective paint.
- D. One fire hydrant repair kit shall be provided for every twenty fire hydrants installed.
- E. Fire hydrants that have been installed but are not ready for service shall be bagged/covered until such time the hydrants are placed into service.

2.13 BLOW-OFFS

- A. Blow-offs shall conform to Plan details and shall be of the type shown. The valve shall meet the requirements for other gate valves and shall be suitable for the anticipated pressure. Blow-offs shall be furnished with concrete valve markers.

2.14 VALVE BOXES

- A. Valve boxes shall be gray iron meeting the requirements of ASTM A48 for Class 30 iron. They shall be constructed to the design and dimensions shown on the plans. The castings shall be free from pouring faults, sponginess, cracks, blow holes, and other defects and they shall be clean of scale and sand so as to present a smooth, clean and uniform surface. The boxes and covers shall be given one (1) shop coat of first quality protective asphaltum paint. Covers shall have the word "WATER" cast in the top.

2.15 CRUSHED STONE

- A. Crushed stone for pipe foundation shall meet ASTM C33 #67 stone graded 2" to 1".

2.16 CONCRETE

- A. Concrete for protection and thrust blocks shall be composed of Portland Cement, sand, coarse aggregate, water, and such admixtures as may be allowed, in such proportions as to provide in minimum compressive strength of 3,000 psi. The source of concrete and mix design shall be approved by the Engineer to use.

PART 3 - EXECUTION

3.1 LOCATIONS

- A. Pipework shall be installed at the locations shown on the Plans and to the position, alignment, and grade shown thereon. Prior to beginning work at any location, the Contractor shall consult with the Engineer and Owner to determine that all rights-of-way, permits, or other legalities are in order. He shall familiarize himself with all conditions and/or limitations of such rights-of-way or permits and shall fully comply with all such requirements. All work shall be confined to rights-of-way or permit limits and any encroachment beyond such limits shall be the Contractor's liability.

3.2 RELATION OF WATER MAINS TO SEWERS

- A. Crossing a Water Main over a Sewer: Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18" above the top of the sewer, unless local conditions or barriers prevent an 18" vertical separation, in which case the water main and sewer shall be constructed of ferrous materials and

with joints that are equivalent to water main standards for a distance of 10' on each side of the point of crossing.

- B. Crossing a Water Main Under a Sewer: Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10' on each side of the point of crossing. A section water main pipe shall be centered at the point of crossing.

3.3 CLEARING AND GRUBBING

- A. Clearing and grubbing, where required, shall be done prior to beginning of pipe installation. It shall be done in accordance with applicable portions of items of General Conditions and the following:
 - B. The Contractor shall consult with the Owner and Engineer prior to starting clearing and a full understanding is to be reached as to procedure. The Contractor shall then conduct clearing and grubbing operations in strict accordance with these agreements.
 - C. Clearing of trees and brush along the pipeline shall be carefully done so that no damage will occur outside of the limits of the right-of-way. Trees and brush must be cut by hand and trees felled within the right-of-way limits.
 - D. Brush, laps, roots, etc., shall be disposed off-site in a manner approved by the Engineer. Burning of trees, brush and debris will not be permitted.
 - E. Grubbing of stumps that are in the way of construction shall be done in any convenient manner which will not cause damage to remaining trees or adjacent property. Stumps shall be disposed as for brush or laps above.
 - F. Limits of the pipe-laying operation shall be confined to the right-of-way and easements. The width of clearing shall be held to a minimum and in no case wider than the right-of-way or easement.

3.4 WORK ON HIGHWAY RIGHT-OF-WAY

- A. The Contractor shall not begin work on any property of the Department of Transportation until necessary permits are in hand. He shall conform to all requirements of the Department of Transportation or its authorized representatives in the prosecution of this portion of the work. It shall be the responsibility of each Bidder to contact the local highway representative and to determine the exact requirements for work to be done. Requirements shall include, but are not limited to the following:
 - B. Where a pipeline crosses under a highway, it shall be installed either by open cut, in tunnel, or in encasement under the highway. Materials and method of crossing shall be indicated on the Plans for each crossing. Where pipe is installed by open cut, at least one full lane for traffic shall be kept open and clear at all times.
 - C. The Contractor shall provide full-time flagmen, with appropriate red flags, at all times when work is in progress.
 - D. Necessary warning and descriptive signs shall be provided and placed at each end of the working area while work is in progress along highways. These signs shall be well tended and shall be placed at sufficient distances from the site of the work so that ample warning is given to approaching traffic. Signs shall be adequately lighted at night.

- E. The Contractor shall keep all streets open to traffic at all times unless permitted otherwise by the Engineer or Department of Transportation as applicable. The Contractor shall provide, place and maintain temporary traffic control devices as directed by the Engineer or Department of Transportation. The latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways as prepared by the National Joint Committee on Uniform Traffic Control Devices shall be used as a guide in the placement of devices and all devices shall meet the requirements of said manual.
- F. Where pipe is installed in open cut across a highway, the cut shall be immediately backfilled and all work of repairing the pavement completed immediately. Any subsequent settlement shall be immediately corrected and repaired.
- G. Where pavement is cut and replaced, the Contractor shall cut the edges to a straight and even line before repairing the pavement. No ragged edges will be allowed or accepted.
- H. Where asphalt pavement or bituminous surfacing is cut, the entire area to be repaired shall be primed with an asphalt prime coat, acceptable to the Department of Transportation before the pavement is replaced.
- I. When required, the Contractor shall furnish to the Department of Transportation a 100% Performance Bond for the amount of work to be undertaken (dry boring or paving to be cut and replaced) along highways. Bond is required in North Carolina.
- J. Unless otherwise indicated, no excavated material shall be placed on the pavement side of the ditch, along State Highways. The least possible amount of trench will be left open when work is not in progress and equipment shall be removed from the pavement and shoulders during shutdown periods.
- K. Shoulders of roadways shall be left in good, acceptable condition and all topsoil and grass that is disturbed shall be replaced.
- L. The Contractor shall pay the cost of all Department of Transportation inspectors time if required on the job.

3.5 WORK ON RAILROAD RIGHT-OF-WAY

- A. The Contractor shall not begin work on any property of the railroad until he has secured necessary permits. He shall conform to all requirements of the railroad, or its authorized representatives, in the prosecution of this portion of the work, including but not limited to the following:
- B. Where a pipeline crosses under a railroad, the work shall be done in accordance with requirements of the Railway Company. Pipe shall be installed by boring and jacking (or open cut as designated). Excavation shall be done ahead of the pipe. The encasement must be kept on accurate line and slightly below grade. A tolerance of 1/2% will be allowed on short lines in good soil and not over 1% in any case.
- C. The Contractor shall furnish the Railway Company the following:
 - 1. Certificate of Worker's Compensation or Employer's Liability Insurance according to the laws of the State.
 - 2. Certificate of the Contractor's Public Liability Insurance, to protect the contractor and subcontractor for loss of life or injury to persons in an amount not less than \$1,000,000 for any one person and not less than and not less than \$1,000,000 for any accident, and for property loss or damage in an amount not less than \$1,000,000 for any one accident

and \$1,000,000 aggregate or larger amounts as required by the railroad encroachment agreements.

3. The original policy of Railroad Protective Liability Insurance naming the Railway Company as the insured for loss of life or injury to persons in an amount not less than \$1,000,000 for one person, and not less than \$1,000,000 for any accident and for property loss or damage in an amount not less than \$1,000,000 aggregate or larger amounts as required by the railroad encroachment agreements. The Railroad Protective Liability Policy should show the location and description of work and name of Owner for whom the work is done.

- D. The Contractor shall also pay the cost of flagmen or other expenses of the railroad in protecting traffic. He shall notify the railroad of the time that the work will be done and shall not begin work until authorized by railroad officials.

3.6 BORED ENCASUREMENT INSTALLATION

- A. Encasement pipe which is dry bored under highways and railroads for installation of water lines shall be installed at the locations, to the gradients, and within the tolerances (if any), as shown on the plans. In event the encasement is installed off grade or seriously out of line, then another encasement pipe will be dry bored as close as practical to the original pipe with no additional compensation allowed therefore. The original encasement must be sealed with a watertight concrete plug (min. 3' deep) at each end.
- B. Any additional pipe or other work required for realignment of the water line with an alternate encasement location which was required due to improper gradient or misalignment in the original installation, shall be completed at the Contractor's expense.
- C. In event an obstruction is encountered during encasement boring operations which cannot be overcome, a second encasement shall be bored at a location designated by the Engineer. No additional compensation will be allowed for the second encasement installation. In event an obstruction is encountered in the second installation, at the direction of the Engineer, a third attempt shall be made to complete the encasement installation. Consideration will be given for additional compensation in event a third installation attempt is required. All abandoned encasement pipes shall be sealed as specified above.
- D. Pipelines installed through steel encasement shall meet specifications herein described and all Department of Transportation or Railroad specifications and guidelines for installing pipelines through steel encasement pipe. Upon insertion of the pipeline through the encasement pipe, the ends of the encasement pipe shall be sealed with brick and mortar. Brick and mortar shall be as herein specified, and the seal shall be such to withstand hydrostatic pressure from ground water and all backfill loads. Contractor shall provide means to prevent water line from floating within the encasement pipe. Grouting procedure will not be allowed.
- E. Casing pipe and joints shall be of leak proof construction, capable of withstanding railway or traffic loading. The diameter of the casing pipe shall be at least 2" greater than the largest outside diameter of the carrier pipe, joints, or couplings for carrier pipe less than 6" in diameter and at least 4" greater for carrier pipe, 6" in diameter and greater, unless indicated differently on drawings. Further, the casing pipe shall be of great enough diameter to allow carrier pipe to be removed subsequently without disturbing the case pipe and immediate areas.
- F. Steel encasement pipe shall be as specified in this section.

3.7 TRENCH EXCAVATION

- A. Trenches for pipe shall be dug true to line and grade and to the following requirements: Depth of cover shall not be less than 3'-0" for pipe up to 8" in diameter and 3'-6" for pipe 10" and larger in diameter, measured to the top of pipe, unless shown differently on the profile or authorized by the Engineer.
- B. Sides of trenches shall be kept as nearly vertical as possible. They shall be at least 12" and not more than 18" wider at the top of the pipe than the outside diameter of the pipe, plus sheathing where it is necessary. Where paving is to be cut, it shall be cut in advance of trenching 1' wider than the specified width of the trench.
- C. Where soil conditions prohibit vertical walls, the trench width at the bottom and at 1' above the top of the pipe shall be as specified above with the remainder being held to the least possible width greater than that specified. Where soil conditions prevent ditch excavation without excessive widths, or where directed by the Engineer, wood sheeting, as hereinafter specified, shall be driven to support the trench walls, or a suitably reinforced steel trench box shall be employed.
- D. Trench bottoms shall be hand graded to provide uniform and continuous bearing for the pipe along its entire length, with bell holes being dug for pipe bells. No ridges, sags, or undercutting will be allowed. Excess excavating below grade shall be backfilled at the Contractor's expense with suitable material which shall be thoroughly stamped.
- E. If approved by the Engineer and subject to suitable soil conditions, the trench may be excavated a few inches below the established subgrade and backfilled with selected material (from the excavation, if available) well compacted and so shaped as to give the pipes uniform bearing throughout their lengths at the established grade. Bell holes shall be dug to relieve the bells of load and to provide for completing the joints.
- F. Where the material at grade is unstable, soft, and incapable of supporting the pipe, the trench shall be excavated below grade, as directed by the Engineer, and refilled to grade with crusher-run stone or gravel to form a firm foundation for the pipe. Stone shall be compacted and graded to provide a stable foundation and a uniform bearing for pipe. Bell holes shall be provided as in other types of foundations.
- G. When authorized by the Engineer, the Contractor shall dispose of material excavated from the trench that is unsuitable for backfill material. The Contractor shall provide in place select borrow material to replace unsuitable material for backfilling the trench as directed.
- H. Should ground water be encountered in the bottom of the trench, causing the trench bottom to be unstable, the material, as directed by the Engineer, shall be excavated below grade sufficiently to allow a bed of crushed rock or gravel to be placed in which to bed the pipe. The work shall be done as for unstable foundations. The depth of cut below grade shall be only the minimum amount to accomplish the purpose, and shall be as directed by the Engineer.
- I. The Contractor shall furnish all machinery for pumping, bailing, and/or well pointing and shall pump, bail, or otherwise remove any water which may be found or shall accumulate in the trenches, and shall perform all work necessary to keep them clear of water while the pipe is being laid. The disposal of water after removal shall be satisfactory to the Engineer.
- J. Whenever necessary, the side of the trench shall be braced and rendered secure and either open or closed sheeting used to the satisfaction of the Engineer; such sheeting and bracing to be left in place until the trench is refilled to a safe limit, not less than 2' above the top of the pipe. The top portion may then be cut off, but the lower portion shall remain undisturbed. In lieu of

sheeting, suitable trench boxes may be employed. All sheeting, bracing, trench boxes, and trench construction methods shall conform to the latest Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970. No extra payment will be made for sheeting and bracing. Such cost shall be included in the cost of installing the pipe.

- K. All existing water, sewer, and gas lines, buried electrical and telephone cable, and other known utilities intersecting the lines of construction, if requested by the Engineer, shall be uncovered by the Contractor at his expense and exposed to the Engineer at least 100' ahead of pipe laying operations of insure the correctness of grades. Existing utilities shown on the Plans are as accurately located as existing records and field surveys allow; however, the Contractor shall verify with the various utility companies before excavating and shall save harmless the Owner from any claims for damages as a result of this work.
- L. The Contractor shall at all times take necessary precautions in preventing gutters, catch basins, ditches and other drainage facilities from being clogged that might cause flooding conditions and damage to public or private properties.
- M. Rock Removal, Blasting
 1. In rock or other unyielding material, the excavation shall be made at least 6" below subgrade elevation. The trench shall be refilled with select material compacted in place as specified for ordinary excavation. Suitable material from excavation may be used, if available. If not, it shall be hauled in.
 2. If rock is encountered, it shall be paid for at the unit price set forth in the Bid. Only solid rock as defined above requiring blasting or drilling for its removal will be classified as rock excavation. Allowance will be made for a width of the trench not in excess of 24" greater than the inside diameter of the pipe and a depth from the surface of the rock to be established subgrade of the pipeline but a minimum of a three foot trench width. Rock excavated in excess of these limits will not be paid for. The Engineer shall measure the amount of rock excavation to be classified as such before the trench is backfilled. No payment will be made for rock excavation which is backfilled before measurement by the Engineer.
 3. All blasting, where required, shall be done under the personal supervision of a man thoroughly skilled in this class of work. All necessary measures to protect life and property shall be taken. When in close proximity to buildings, transmission lines, telephone lines or other facilities, timber mats or other means of preventing damage from flying debris shall be used. Ample and suitable signals shall be given in proximity to the work before each blast, and flagmen shall be placed on all roads, beyond the danger zone, in every direction to warn traffic. All responsibility for damage rests on the Contractor.

3.8 PIPE INSTALLATION

- A. The Contractor shall haul the pipe and appurtenances to the site of the work and distribute them neatly along the trench prior to laying. The pipe shall be carefully handled to prevent damage. Mechanical hoists or other approved methods shall be used in the handling. Depth of cover shall not be less than 3'-0" for pipes 8" in diameter or 3'-6" for pipes 10" and larger in diameter, measured to the top of pipe, except where shown differently on a profile or specifically authorized by the Engineer.
- B. Pipe and appurtenances shall be kept clean and open ends securely plugged when pipe and bell and spigots shall be thoroughly inspected and cleaned prior to lowering into the ditch and care

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shall be exercised after the pipe is in place to prevent dirt or other extraneous material from getting into the pipe or bells and into the spigot.

- C. Spigots shall be fully seated in the bells and the pipe shall be uniformly bedded on the bottom of the trench for its entire length with bells lying in previously dug bell holes sufficiently large to allow proper bedding and jointing. Fitting, valves, and other appurtenances shall be located where shown on the Plans or directed by the Engineer, with the pipe being cut where necessary. After joining, a reasonable amount of deflection may be made in the joint. Such deflection shall not exceed the allowable amount specified by the manufacturer for each size of pipe.
- D. Cast iron pipe shall be laid in accordance with the manufacturer's instructions, applicable portions of AWWA Specification C600, and the following:
 - 1. For mechanical joint pipe, Type II, the rubber rings shall be properly lubricated and spigots and bells cleaned before assembling the joint. Units of bolted joints shall be tightened with special torque limiting wrenches set to provide the proper strain on the bolt, and all nuts tightened to that limit.
 - 2. Rubber ring joints, Type III, shall be assembled in accordance with the manufacturer's instructions. The bell and spigot shall be absolutely clean prior to the seating of the gasket. The gasket shall be wiped clean, flexed and properly inserted into the socket and seated evenly and properly. Care shall be taken to eliminate any bulges which might interfere with the proper entry of the spigot. A thin film of lubricant shall be applied to the inside surface of the gasket. The joint shall then be completed by forcing the spigot into the bell until it makes contact with the bottom of the gasket. This shall be done by use of a pipe jack and assembly, or other methods as approved by the Engineer.
- E. PVC pipe shall be installed to all applicable portions of requirements for other pipe material and to the exact instructions of the manufacturer. Adapters shall be furnished and installed as necessary when connections are made to other types of pipe.
- F. Fittings shall be installed where shown on the Plans or directed by the Engineer. They shall be handled and installed in the same manner as the pipe and all shall be well blocked as hereinafter specified.
- G. Valves shall be installed at the locations shown on the Plans. They shall be carefully handled, cleaned, and checked for operation prior to backfilling. Care shall be taken to insure that no dirt, rock, or other obstacles that would interfere with the valve operation are left in the valve.
- H. A valve box shall be installed with each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The base shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be furnished where depth of bury places operating not in excess of 4' beneath finished grade.
- I. Fire hydrants shall be installed in the locations shown on the Plans, or as directed by the Engineer. They shall, in general, be set well back of the curb or ditch line, with the break ring approximately 2" above the finished ground or pavement elevation. A minimum of four cubic feet of stone shall be placed under and around the bottom of each hydrant to facilitate its drainage. Hydrants shall be well blocked with concrete and connected back to the main with tie rods as hereafter specified. Each hydrant shall be painted, after installation, with an acceptable paint and of color(s) selected by the Owner. After installation and prior to being placed into service, each fire hydrant shall be covered with a burlap bag to indicate that the fire hydrant is not in service.

- J. Valve markers shall be installed for each valve and blow-off and shall be set where directed by the Engineer. They shall be carefully set with the letters facing the valves and shall be plumb.
- K. Concrete for blocking and protection shall be poured in accordance with the following requirements: All fittings, bends, dead ends, fire hydrants, etc., shall be acceptably blocked with concrete having bearing on undisturbed earth in the side and/or bottom of the trench. Bearing area shall be equal to that shown on the Plans and greater if deemed necessary by the Engineer. No concrete shall be poured or splattered on fitting bells, glands, or bolts.

3.9 BACKFILLING

- A. All trash, forms, debris, and other foreign material shall be cleared from around all pipes and structures before backfilling.
- B. Backfilling of trenches shall be completed after the installation of each section of pipe. Backfilling shall be kept up with the pipe laying to the satisfaction of the Engineer.
- C. Backfilling around the pipe and to a depth of at least 1' above the top of pipe shall be placed by hand in layers of not over 6". Only select material containing no rocks or other objectionable material shall be used for this portion of the backfill. As fast as the material is placed, it shall be cut under the haunches of the pipe with a shovel and thoroughly compacted with mechanical tamps for the full width of the trench to provide support for the bottom and sides of the pipe. Filling shall be carried up evenly on both sides.
- D. The balance of the backfill shall be placed and tamped to prevent excessive settlement in a manner satisfactory to the Engineer. If the trench backfill is located under miscellaneous paved areas, areas to be paved, or unpaved streets, the trench shall be backfilled with suitable material free from large stones or clods in 8" layers (loose measurement) and thoroughly tamped and compacted to 95% of maximum as established by AASHTO Specification T99, Method A, with mechanical tampers, so as to avoid future settlement. Where applicable, the compaction shall be acceptable to the Department of Transportation or Owner. For trenches located in streets and highways, trench backfilling shall be in accordance with the requirements of item 3.11 of this section, Cutting and Replacing Pavement.
- E. For pipe outside street limits, compaction shall be at least 90% of maximum as established by AASHTO Specification T99, Method A.
- F. Excess material shall be promptly removed from the site, and the pavement or road surface cleaned of objectionable material. The pavement and/or road surface shall be cleaned daily with a mechanical broom and/or washed if requested by the Engineer or Department of Transportation officials.
- G. In unpaved streets and shoulders of roads, the top 6" of trench shall be filled with stone for unpaved streets and well compacted topsoil for shoulders. In paved areas, the top of the trench shall be filled with the specified base for pavement, well mixed and compacted. Any settlement of backfill below finish grade shall be promptly corrected.
- H. The Contractor will be responsible for all final subsidence of all trenches and shall leave the same flush with the original ground after all settlement has taken place. Trenches must be protected against scour due to surface drainage. The Contractor shall correct any future settlement within the guarantee period at his own expense.

3.10 DUST CONTROL

- A. The Contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. The Contractor will not be directly compensated for any dust control measures necessary, as this work will be considered incidental to the work covered by the various contract items. The Contractor will provide dust control measures as directed by the Engineer.

3.11 CUTTING AND REPLACING PAVEMENT

- A. Where pavement is to be cut for installation of pipe or other utilities, the Contractor shall cut it neatly in advance of trenching and shall replace the pavement with base and new pavement.
- B. All pavement shall be neatly cut to a straight edge in advance of trenching with the method of cutting being subject to approval of the Engineer. Pavement shall be cut 12" wider than the excavated area on each side. Ragged or irregular edges will not be allowed and work completed with barred edges shall be redone. Concrete pavement shall be sawed with suitable concrete saw cutting equipment.
- C. Trench backfilling shall be done in layers not over 6" thick and thoroughly compacted. Compaction shall be such as to prevent future settlement and shall be done by acceptable means, approved by the Engineer. Rolling with rubber tired vehicles or track-type equipment will not be allowed. Compaction shall be at least 95% of maximum as established by AASHTO Specification T99, Method A.
- D. Base for pavement shall be crusher run stone for all non-NCDOT maintained streets, HB binder for all secondary highways, and reinforced concrete for all primary highways. All base shall be placed in accordance with plan and/or encroachment permit details. Base width shall be shown on the plans and/or encroachment permits for various types of pavement cuts.
 - 1. Crusher run stone shall conform to the requirements of Section 02231. It shall be well mixed and compacted by tamping and rolling. Compaction shall be to such degree as to preclude settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to top of ditch, to be cut out and replaced with base material at a later date, will not be allowed.
 - 2. Crusher run base for highway pavement and adjacent drives shall be 8" of stone, stabilized with 5% Portland Cement. It shall be thoroughly mixed prior to compacting.
 - 3. Crusher run base for non-highway pavement and drives shall be 8" of stone without the addition of cement.
 - 4. Binder base for secondary roads shall be a minimum of 6" HB binder conforming to specifications of the Department of Transportation.
 - 5. Concrete base shall consist of 8" of concrete, reinforced with #4 reinforcing steel bars placed at 8" on center in the transverse direction and #4 tie bars in the longitudinal direction. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days. The design of the mix and source of supply shall be subject to approval of the Engineer.
 - 6. Pavement shall be replaced with the same type of pavement that exists prior to cutting and shall consist of either bituminous surface course (double treatment), 2" of hot plant mix asphaltic concrete, or 8" of Portland Cement concrete; all conforming to specifications of the Department of Transportation for each type.

- a. All pavement shall be repaired within the same week that it is cut. Should inclement weather delay pavement replacement, the Contractor shall not cut additional pavement until he has notified the Engineer and received specific permission and instructions.
- b.
- c. For asphalt pavement or bituminous surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an acceptable asphalt prime coat just prior to placing new pavement.

3.12 REMOVING AND REPLACING SIDEWALK, OTHER ITEMS

- A. Where pipe is to be placed under existing concrete sidewalk, the concrete shall be removed in construction units unless their length is more than 10', in which case the concrete shall be cut as specified in paragraph 3.11.B. of this section. The backfill shall be thoroughly compacted for the entire depth of the trench.
- B. The sidewalk shall be replaced with 3000 psi concrete, 4" thick, except for driveways where it shall be 6" thick. The concrete shall be placed monolithic and dressed off with a wooden float, brush and edging tool. Where pipe is to be placed under concrete walk, the Contractor may, with the permission of the Engineer, install the pipe by tunneling instead of removing and replacing the walk. If pipe is to be placed under curb and gutter, it shall be done by tunneling. No additional payment will be made therefore.
- C. The Contractor shall be responsible for removing and replacing items such as signage, mail boxes, fences, shrubbery, walls, steps, and any other private ornamental items that are in direct conflict with the water line work. No additional payment will be made therefore.

3.13 CONNECTIONS TO EXISTING MAINS

- A. Connections to existing facilities shall be made where shown on the plans or directed by the Engineer. Wet taps, using tapping sleeves and valves, shall generally be made; except as otherwise directed or planned in which case the main shall be cut and the connections made with fittings and valves. In no case shall the Contractor shut off the water or operate the fire hydrants or gate valves in the existing systems without the expressed permission of the Owner. In event such instructions or permissions given by the Owner delays the cutoff, such instructions shall be followed without recourse.
- B. In making connections to the old distribution system, valves shall be set as shown on the Plans, or at such designated places as the Engineer may direct. If due to unforeseen conditions, these locations have to be changed or additional valves or fittings added, the Contractor shall install the valves or fittings at the new locations at the unit bid price therefore.

3.14 REPAIRS TO DAMAGED SERVICES AND UTILITIES

- A. Repairs to damaged services and utilities shall be promptly made at the Contractor's expense. The Contractor shall use every effort to avoid damaging or breaking water, sewer, gas, power, telephone, or other utility service. Utility lines shall be properly supported across the pipe trench until backfilling is completed. Should damage occur, immediate action shall be initiated to affect satisfactory repairs. All repair work shall be satisfactory to the Engineer and Owner of the damaged utility.

3.15 CLEANUP

- A. All pipeline rights-of-way and pipework areas shall be cleaned up and left in satisfactory condition.
- B. Cleanup of work along highways or roads shall be made immediately upon completion of the backfill operation. Ditching and pipe laying shall be stopped at any time that cleanup work lags and shall not be resumed until cleanup progress is satisfactory to the Engineer. Final cleanup and condition of the work area shall be subject to the approval of the State Highway Representative, the Owner, and the Engineer.
- C. Cleanup of work for cross-county locations shall follow immediately upon the completion of any major part of the work or upon instructions by the Engineer. Topsoil shall be replaced on all areas disturbed by the pipeline work throughout the length of the water main, and to the full satisfaction of the property owner. Topsoil may be removed from the line of work and stockpiled for future use. It shall be carefully removed, stockpiled, protected, respread, dressed off, and the entire right-of-way left in condition acceptable to the Engineer and property owner. If topsoil is not stockpiled and protected, suitable, approved material from other sources shall be provided. Where the line is located on pasture land, grassed areas, or roadway shoulders, grass shall be replaced.
- D. All disturbed pipeline areas shall be seeded in accordance with Section 02480.

3.16 INSPECTION AND ACCEPTANCE

- A. All work shall be subject to inspection and approval prior to final acceptance and payment. Final acceptance shall be contingent upon the following:
 - 1. All pressure and leakage tests shall yield satisfactory results.
 - 2. All bacteria samples shall be negative.
 - 3. Final cleanup will meet the approval of the Engineer, the Owner, and property owner where applicable, with all defects in trench settlement, pavement patches or other deficiencies being promptly corrected.
 - 4. All complaints are satisfactorily resolved.
 - 5. Accurate as-built information is received.

END OF SECTION 02713

PENDER COUNTY LAW ENFORCEMENT CENTER
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SECTION 02722 - WATER MAINS Revision Date October 12, 2021
Town of Burgaw Specifications

PART 1 - DESCRIPTION OF WORK:

- A. Work under this section consists of furnishing all plant, labor, materials, and equipment for the installation of sanitary services and appurtenances.

1.2 QUALITY ASSURANCE:

A. Standards:

1. American Association of State Highway Transportation Officials
 - a. AASHTO T99
2. American National Standards Institute
 - a. ANSI A21.50 Ductile cast iron pipe
 - b. ANSI A21.51 Ductile cast iron pipe
3. American Society for Testing and Materials
 - a. ASTM A74 cast iron soil pipe
 - b. ASTM A252 encasement pipe
 - c. ASTM C12 clay pipe
 - d. ASTM C14 concrete sewer pipe (18 in. and smaller)
 - e. ASTM C32 manhole brick
 - f. ASTM C33 crushed stone
 - g. ASTM C76 concrete sewer pipe (larger than 18 in.)
 - h. ASTM C91 masonry cement
 - i. ASTM C139 concrete manhole block
 - j. ASTM C230 grout and mortar
 - k. ASTM C301 clay pipe
 - l. ASTM C425 pipe joints
 - m. ASTM C443 pipe joint material and fittings
 - n. ASTM C478 precast concrete manholes
 - o. ASTM C594 flexible couplings and fittings
 - p. ASTM C700 clay pipe
 - q. ASTM D1869 pipe fittings
 - r. ASTM D2152 pipe testing
 - s. ASTM D2321 pipe installation
 - t. ASTM D2412 pipe testing
 - u. ASTM D2444 pipe testing
 - v. ASTM D2680 ABS composite pipe
 - w. ASTM D2751 ABS sewer service line
 - x. ASTM D3034 PVC gravity sewer pipe
4. Federal Specifications

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- a. WW-P-421 ductile cast iron pipe
- B. Soil Testing
1. The Owner shall retain the services of a testing laboratory to perform all tests required at the project site. In areas of fill and backfill, field density tests shall be performed in sufficient numbers to insure that the specified density is obtained. These tests shall be performed at no cost to the Contractor with the following exceptions:
 - a. The cost of any tests or investigations which result in the identification of defective work or material or improper placement or compaction shall be borne by the Contractor.
 - b. The Contractor shall be responsible for the cost of testing borrow material which shall include standard density tests (Proctor curves).
 - c. All defective work or material shall be repaired and/or replaced by the Contractor at no cost to the Owner. Areas in which testing indicates compaction below the specified density shall be reworked, or removed and replaced by the Contractor, at no expense to the Owner, until specified compaction is obtained.
- C. Soil Erosion Control
1. Siltation, sedimentation, and erosion shall be kept to a minimum at all times during construction. Sedimentation and erosion control methods shall be employed by the Contractor during construction in order to comply with the requirements of the N.C. Sedimentation Pollution Control Act of 1973, and to plan requirements.
- D. Material Testing
1. PVC, PVC Truss Pipe, and ABS Truss Pipe
 - a. PVC pipe shall be tested at the pipe factory with their own in-house quality control methods in accordance with ASTM Specifications D2412, D2152, and D2444 for PVC pipe. A test certificate shall be furnished to the Engineer by the factory for each 5,000' of pipe shipped to the site, showing that each joint of pipe conforms to these specifications. Each joint of pipe shall be stenciled with the manufacturer's initials and any pipe arriving at the job site unstenciled will be rejected. The Owner reserves the right to have the same test run by an independent laboratory and the results of the test furnished to the Engineer. The Owner will pay all cost of testing by an independent laboratory not normally conducted by the pipe manufacturer.
 2. Other Materials
 - a. Other material shall be subject to such testing as the Engineer may require should its acceptability be questioned.
 3. Cost for Testing Method
 - a. All costs for testing of materials by an independent laboratory not normally conducted by the factory shall be paid for by the Owner.
- E. Inspection, Testing, and Acceptance - New Pipelines
1. Inspection
 - a. Upon completion of each section of sewer or at such time as the Engineer may direct, a block or section of sewer shall be cleaned and inspected. All repairs shown necessary by the inspection shall be made. Broken or cracked pipe shall be replaced; defective joints, if any, replaced; all deposits removed; and the sewer left true to line and grade, entirely clean, free from lumps or protruding jointing

material, etc., and ready for use. Each section of sewer between manholes shall show, upon examination from either end, a reasonably full circle of light.

- b. Manholes shall be true circles of acceptable brick or block work, or for precast manhole, shall have no major defects. Tops shall be properly placed, and castings securely in place. Manholes shall show absolutely no evidence of leakage through the walls or bottom.
2. Testing
- a. Infiltration and exfiltration shall be kept to the minimum amount possible. The allowable limit of groundwater infiltration/exfiltration for any or more selections of sewer with any type joint, including service lines, allowable under these specifications (all sizes), shall not exceed 50 gallons per 24 hours per mile of sewer line per inch of diameter.
 - b. Any line that does not meet this specification will be rejected and must be repaired at the Contractor's expense.
 - c. No infiltration tests will be made until normal infiltration conditions are established. Tests shall be made before existing sewers or connections are made to new service lines and shall be measured by means of a V-notch weir inserted into the line at a manhole or built in a manhole. These tests will be conducted over a period of time sufficient to determine the correct rates of groundwater infiltration. Weir measurements shall be made at points designated by the Engineer along the completed pipelines, and at least one measurement shall be made for each pipe segment between manholes if requested by the Engineer. All expense of the above test or tests shall be borne by the Contractor and be included in the unit price bid per foot of sewer under each respective size of sewer. When infiltration occurs in excess of the specified amounts as hereinabove given, defective pipe or joints shall be located and repaired at the expense of the Contractor. If the defective portions cannot be so located, the Contractor shall, at his own expense, remove and reconstruct as much of the original work as necessary to obtain a sewer within the allowable infiltration limits upon retesting.
 - d. Where lines are above the ground water table, exfiltration testing will be required. Also for lines that may be seasonally under the ground water table or flood levels but, due to dry conditions, upon completion of construction normal infiltration conditions are not present (or the normal wet weather ground water level is not present), the Contractor has the option of conducting exfiltration tests in lieu of infiltration tests. Test procedure shall be as follows:
 - 1) Plug lower end of section to be tested.
 - 2) Fill line and manholes with water so that the level in the manhole furthest upstream is at least 3' above the top of the pipe, or a level as determined by the Engineer that models the height of the wet weather groundwater table or the local surface level during flood conditions.
 - 3) Let water stand overnight or at least 4 hours to allow all air to escape and sewer line to reach its maximum absorption.
 - 4) After pipe has reached its maximum absorption, refill upstream manhole to original depth. After test period specified by the Engineer, record difference in elevation of water level and compute exfiltration rate. Minimum test period shall be six (6) hours.

- 5) When the leakage exceeds the specified amount, satisfactory correction shall be made. Both the measurement and the correction shall be made at no additional cost to the Owner.
- 6) Deflection Tests: All PVC, ABS composite, and PVC composite pipe shall be tested 30 days after installation and backfill to insure that deflection of the pipe does not exceed 5%. All pipe segments with deflections in excess of 5% shall be promptly relayed with proper bedding and retested for 5% deflection at the Contractor's expense. The deflection test shall require passing a mandrel with a calibrated diameter through each pipe segment. Deflection tests shall be conducted and paid for by the Contractor.

1.3 SUBMITTALS:

- A. Shop drawings shall be submitted to the Engineer in accordance with the General Conditions for the following items:
 1. Precast manholes
 2. Metal castings
 3. Transition couplings
- B. Manufacturer's certifications shall be submitted to the Engineer certifying that the following materials meet all requirements of the specifications:
 1. Sewer Main Pipe
 2. Sewer Service Pipe
 3. Sewer Pipe Fittings
 4. Precast Manholes
- C. Mix designs for concrete and asphalt shall be submitted to the Engineer for approval, if requested by the Engineer.
- D. Three (3) copies of all submittals are required. None of the above listed equipment or materials shall be used on the project unless the necessary approval for that particular item has been given by the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All materials and appurtenances shall meet the following minimum standard requirements therefor. It shall be each manufacturer's responsibility to check the proposed installation and to furnish material that will be fully capable of performing its intended function.
- B. Pipe shall be of the type, size, class, and diameter as hereinafter specified and called for by the Plans and/or Bid. Pipe shall be ductile cast iron, ABS composite type, PVC composite type, and/or polyvinyl chloride.
- C. Trench width for buried pipe design shall be considered as the outside diameter of the pipe plus 2', at the bottom and up to 1' above the top of the pipe.
- D. Buried pipe shall be designed for laying condition per standard details to withstand all internal pressures and external loads with a minimum depth to cover of 3', and greater depths of cover

where required by the Plans, plus an H- 20 live load in accordance with A.A.S.T.H.O. Specifications.

2.2 DUCTILE CAST IRON PIPE:

- A. Ductile cast iron pipe shall be in conformance with the following requirements:
1. Ductile cast iron pipe shall be Grade 60-42-10 ductile cast iron conforming to Federal Specification WW-P-421, Grade C and ANSI A21.51. Ductile cast iron shall be of thickness as required for trench, backfill, and loading conditions, strictly as determined by ANSI A21.50 -- Thickness Design 1 of Ductile Iron Pipe." Pipe shall have a bituminous coating on the inside and outside. As indicated on the plans, a special interior coating shall be used which shall be Protecto 401 ceramic lining as manufactured by U.S. Pipe, Sewper Coat as manufactured by Lafarge Calcium Aluminum, or equal. All linings and coatings shall be per manufacturer's specifications and conform to ANSI/AWWA C151/A21.51.
 2. Joints shall be rubber gasketed, push-on type, unless specifically shown otherwise. The letters "DI" or "Ductile Iron" shall be stamped on the pipe.

2.3 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE:

- A. PVC gravity sewer pipe shall be type PSM conforming to ASTM D3034, SDR-35, with bell and spigot rubber O-ring gasketed joints. The standard length of pipe shall be 12.5' "1". All fittings and accessories shall have bell and spigot configurations identical to pipe.

2.4 POLYVINYL CHLORIDE (PVC) LARGE DIAMETER GRAVITY SEWER PIPE:

- A. PVC large diameter gravity sewer pipe and fittings shall be type DR-18 C-900, with bell and spigot rubber O-ring gasketed joints. The standard laying lengths shall be 12.5' for 18" diameter and 12' for 12", 24", and 27" diameter pipe. All fittings and accessories shall have bell and spigot configurations identical to the pipe.

2.5 STEEL ENCASUREMENT PIPE:

- A. Steel encasement pipe shall be bituminous coated inside and outside. Bituminous coating shall be 6 mil. minimum thickness. Steel encasement pipe shall have a minimum wall thickness as indicated on the plans for bores under railroads and for bores under highways and shall meet ASTM Specifications A252 with a minimum yield strength of 35,000 psi.

2.6 TEES, WYES, AND MISCELLANEOUS FITTINGS:

- A. Fittings for service connections on new main lines shall be the same material as the main and shall conform to the above applicable specifications. A tapping saddle shall be used for service taps on existing mains. All fittings for cleanout assemblies shall be the same material as the service line pipe including combination wye and bend, vertical riser, and cleanout plug and cap. All service connections shall conform to the details as shown on the Plans.

2.7 MANHOLE MATERIAL:

- A. Manhole material shall consist of precast concrete in accordance with the following requirements. All material shall be approved by the Engineer prior to use.
- B. Precast concrete manholes shall consist of precast reinforced concrete sections, a conical or flat top section as required, and a base section conforming in general to the details shown on the

Plans. Precast manhole sections shall be manufactured in accordance with ASTM Specification C478. The minimum compressive strength of the concrete for all sections shall be 4,000 psi. The maximum allowable absorption of the concrete shall not exceed 8% of the dry weight.

- C. The manhole shall have flexible coupling cast into the manhole making it an integral part of the manhole at each inlet and outlet hole. This coupling shall be rigid, secure, and provide water tightness, yet provide flexibility at the pipeline to manhole connection.
- D. At the Contractor's option, the manholes may be furnished as follows:
 - 1. Full diameter with eccentric cone at top of manhole; or
 - 2. Full diameter base above top of largest pipe with a five-foot diameter riser barrel to top of manhole; or
 - 3. Fabricated tee base to top of largest pipe with a five-foot diameter riser barrel to top of manhole.
- E. Manholes shall not be less than 6 feet in depth from rim elevation to invert out. Manholes less than 5 feet depth shall be approved by the Town and be provided as flat top per Town details.

2.8 MASONRY CEMENT:

- A. Masonry cement shall be of best grade, conforming to ASTM Specification C91, Type II, of a brand approved by the Engineer. It shall be newly manufactured, well housed, and kept dry and protected at all times.

2.9 CASTINGS AND STEPS:

- A. Castings and steps shall be provided for each manhole. Frames, covers, and steps shall be of cast iron of superior quality, tough and even texture, and of not less than 40% pig. They shall be clear of blow holes, and holes, cracks, or other defects, properly finished and bituminous coated while hot.
- B. Manhole covers, frames, and steps shall conform to the details for each type manhole on the Plans, or to similar plans differing in detail but of equally good design, provided such castings are approved by the Engineer prior to use. Covers and frames shall be machined to provide plane, smooth surfaces for uniform seating and interchangeability of covers. Rings and covers that provide imperfect seating will be rejected. All covers and frames shall be suitable for traffic service. Minimum opening shall be 22" in diameter, minimum weight of cover shall be 120 pounds and minimum weight of frame shall be 190 pounds.
- C. Special frames and covers shall be provided for sealing manholes water tight at locations shown on the Plans. These frames and covers shall conform to the above specifications and shall be provided with a one piece rubber gasket seated into the manhole frame. Covers shall be secured with 4 minimum 2" lug bolts. Such frames and covers shall be manufactured by Neenah Foundry, Dewey Brothers, Inc., or equal.

2.10 CONCRETE:

- A. Concrete for piers, protection, and other uses shall be composed of Portland cement, sand, coarse aggregate, water and such admixtures as may be allowed in such proportions as to provide a minimum 28-day compressive strength of 3,000 psi. The source of concrete and mix design shall be approved by the Engineer prior to use.

2.11 GROUT AND MORTARS:

- A. Non-shrink, high strength grout shall be a non-shrink catalyzed metallic mortar that provides high strength, and does not need rigid confinement. It shall be premixed and used in proportion with water as recommended by the manufacturer. It shall be compatible with other grouts and mortars used. It shall be manufactured by Master Builders, Five Star, W.R. Grace Company, or equal.
- B. Hydraulic cement grout shall be a cement base, quick set compound which effectively and permanently stops hydrostatic water infiltration through concrete or masonry. It shall be used as recommended by the manufacturer. It shall be "waterplug" as manufactured by Thoro System Products, "Preco Plug" as manufactured by Fosroc Preco, or equal.
- C. Hydraulic waterproof sealant shall be cementitious base grouting compound designed specifically for providing a hydraulic waterproof coating for concrete or masonry walls, which when applied, becomes an integral part of the concrete or masonry surface. It shall be "Thoro-seal" as manufactured by Thoro System Products, "Brush-Bond" as manufactured by Fosroc Preco, or equal.

2.12 CRUSHED STONE:

- A. Crushed stone for pipe bedding shall conform to ASTM C33, size no. 57.

2.13 PIPE ADAPTERS:

- A. Connections between dissimilar pipe materials or pipe with different diameters shall be made using flexible couplings with stainless steel bands conforming to ASTM Specification C594-70, or using PVC adapter "donut" fittings conforming to applicable portions of ASTM Specifications C443, C425, C594, and D1869. A Smith-Blair Type 242 or 243 with 6" band width, CLOW CORP., Type 1202 or 1212, or equal, all purpose repair clamp will be acceptable. Concrete collars will not be allowed unless specifically called for or directed by the Engineer in the field.

PART 3 - EXECUTION

3.1 LOCATIONS:

- A. Pipework shall be installed at the locations shown on the Plans and to the position, alignment, and grade shown thereon. Prior to beginning work at any location, the Contractor shall consult with the Engineer and Owner to determine that all rights-of-way, permits, or other legalities are in order. He shall familiarize himself with all conditions and/or limitations of such rights-of-way or permits and shall fully comply with all such requirements. All work shall be confined to rights-of-way or permit limits and any encroachment beyond such limits shall be the Contractor's liability.

3.2 RELATION OF SEWERS TO WATER MAINS:

- A. Crossing a sewer under a water main: Whenever it is necessary for a sewer to cross under a water main, the sewer shall be laid at such elevation that the top of the sewer is at least 18" below the bottom of the water main, unless local conditions or barriers prevent an 18" vertical separation -- in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10' on each side of the point of crossing.

- B. Crossing a sewer over a water main: Whenever it is necessary for a sewer to cross over a water main, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10' on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

3.3 CLEARING AND GRUBBING:

- A. Clearing and grubbing, where required, shall be done prior to beginning of pipe installation. It shall be done in accordance with applicable portions of items of General Conditions and the following:
 - B. The Contractor shall consult with the Owner and Engineer prior to starting clearing and a full understanding is to be reached as to procedure. The Contractor shall then conduct clearing and grubbing operations in strict accordance with these agreements.
 - C. Clearing of trees and brush along the pipeline shall be carefully done so that no damage will occur outside of the limits of the right-of-way. Trees and brush must be cut by hand and trees felled within the right-of-way limits.
 - D. Brush, laps, roots, etc., shall be disposed off-site in a manner approved by the Engineer. Burning of trees, brush and debris will not be permitted.
 - E. Grubbing of stumps that are in the way of construction shall be done in any convenient manner which will not cause damage to remaining trees or adjacent property. Stumps shall be disposed as for brush or laps above.
 - F. Limits of the pipe-laying operation shall be confined to the right-of-way and easements. The width of clearing shall be held to a minimum and in no case wider than the right-of-way or easement.

3.4 WORK ON HIGHWAY RIGHT-OF-WAY:

- A. work on any property of the Department of Transportation until necessary permits are in hand. He shall conform to all requirements of the Department of Transportation or its authorized representatives in the prosecution of this portion of the work. It shall be the responsibility of each Bidder to contact the local highway representative and to determine the exact requirements for work to be done. Requirements shall include, but are not limited to the following:
 - B. Where a pipeline crosses under a highway, it shall be installed either by open cut, in tunnel or in encasement under the highway. Materials and method of crossing shall be as indicated on the plans for each crossing. Where pipe is installed by open cut, at least one full lane for traffic shall be kept open and clear at all times.
 - C. The Contractor shall provide full-time flagmen, with appropriate red flags, at all times when work is in progress.
 - D. Necessary warning and descriptive signs shall be provided and placed at each end of the working area while work is in progress along highways. These signs shall be well tended and shall be placed at sufficient distances from the site of the work so that ample warning is given to approaching traffic. Signs shall be adequately lighted at night.
 - E. The Contractor shall keep all streets open to traffic at all times unless permitted otherwise by the Engineer or Department of Transportation as applicable. The Contractor shall provide, place and maintain temporary traffic control devices as directed by the Engineer or Department of Transportation. The latest edition of the Manual on Uniform Traffic Control Devices for Streets

and Highways as prepared by the National Joint Committee on Uniform Traffic Control Devices shall be used as a guide in the placement of devices and all devices shall meet the requirements of said manual.

- F. Where pipe is installed in open cut across a highway, the cut shall be immediately backfilled and all work of repairing the pavement completed immediately. Any subsequent settlement shall be immediately corrected and repaired.
- G. Where pavement is cut and replaced, the Contractor shall cut the edges to a straight and even line before repairing the pavement. No ragged edges will be allowed or accepted.
- H. Where asphalt pavement or bituminous surfacing is cut, the entire area to be repaired shall be primed with an asphalt prime coat, acceptable to the Department of Transportation before the pavement is replaced.
- I. When required, the Contractor shall furnish to the Department of Transportation a 100% Performance Bond for the amount of paving to be cut and replaced along highways. Bond is required in North Carolina.
- J. Unless otherwise indicated, no excavated material shall be placed on the pavement side of the ditch, along State Highways. The least possible amount of trench will be left open when work is not in progress and equipment shall be removed from the pavement and shoulders during shutdown periods.
- K. Shoulders of roadways shall be left in good, acceptable condition and all topsoil and grass that is disturbed shall be replaced. Grassing shall include seeding fertilizing, and mulching to conform with the Department of Transportation requirements.
- L. The Contractor shall pay the cost of all Department of Transportation inspectors time, if required on the job.

3.5 WORK ON RAILROAD RIGHT-OF-WAY:

- A. The Contractor shall not begin work on any property of the railroad until he has secured necessary permits. He shall conform to all requirements of the railroad, or its authorized representatives, in the prosecution of this portion of the work, including but not limited to the following:
- B. Where a pipeline crosses under a railroad, the work shall be done in accordance with requirements of the Railway Company. Pipe shall be installed by boring and jacking (or open cut as designated). Excavation shall be done ahead of the pipe. The encasement must be kept on accurate line and slightly below grade. A tolerance of 2% will be allowed on short lines in good soil and not over 1% in any case.
- C. The Contractor shall furnish the Railway Company the following:
 - 1. Certificate of Worker's Compensation or Employer's Liability Insurance according to the laws of the State.
 - 2. Certificate of the Contractor's Public Liability Insurance to protect the Contractor and Subcontractor for loss of life or injury to persons in an amount not less than \$1,000,000 for any one person, not less than \$1,000,000 for any one accident; and for property loss or damage in an amount not less than \$1,000,000 for any one accident and not less than \$1,000,000 aggregate or as required by the Railroad Company.

3. The original policy of Railroad Protective Liability Insurance naming the Railway Company as the insured for loss of life or injury to persons in an amount not less than \$1,000,000 for one person, and not less than \$1,000,000 for any accident and for property loss or damage in an amount not less than \$1,000,000 aggregate. The Railroad Protective Liability Policy should show the location and description of work and name of Owner for whom the work is done.

D. The Contractor shall also pay the cost of flagmen or other expenses of the railroad in protecting traffic. He shall notify the railroad of the time that the work will be done and shall not begin work until authorized by railroad officials.

3.6 BORED ENCASEMENT INSTALLATION:

A. Encasement pipe which is dry bored under highways and railroads for installation of sewer lines shall be installed at the locations, to the gradients, and within the tolerances (if any), as shown on the plans. In event the encasement is installed off grade or seriously out of line, then another encasement pipe will be dry bored as close as practical to the original pipe with no additional compensation allowed therefor. The original encasement must be sealed with a watertight concrete plug (min. 3' deep) at each end.

B. Any additional pipe or other work required for realignment of the sewer line with an alternate encasement location which was required due to improper gradient or misalignment in the original installation, shall be completed at the Contractor's expense.

C. In event an obstruction is encountered during encasement boring operations which cannot be overcome, a second encasement shall be bored at a location designated by the Engineer. No additional compensation will be allowed for the second encasement installation. In event an obstruction is encountered in the second installation, at the direction of the Engineer, a third attempt shall be made to complete the encasement installation. Consideration will be given for additional compensation in event a third installation attempt is required. All abandoned encasement pipes shall be sealed as specified in paragraph 3.6.A above.

D. Pipelines installed through steel encasement shall meet specifications herein described and all Department of Transportation or Railroad specifications and guidelines for installing pipelines through steel encasement pipe. Upon insertion of the pipeline through the encasement pipe, the ends of the encasement pipe shall be sealed with brick and mortar. Brick and mortar shall be as herein specified, and the seal shall be such to withstand hydrostatic pressure from ground water and all backfill loads. Contractor shall provide means to prevent line from floating within the encasement pipe. Grouting procedure will not be allowed.

E. Casing pipe and joints shall be of leakproof construction, capable of withstanding railway or traffic loading. The diameter of the casing pipe shall be at least 2" greater than the largest outside diameter of the carrier pipe, joints, or couplings for carrier pipe less than 6" in diameter and at least 4" greater for carrier pipe, 6" in diameter and greater, unless indicated differently on drawings. Further, the casing pipe shall be of great enough diameter to allow carrier pipe to be removed subsequently without disturbing the case pipe and immediate areas.

F. Steel encasement pipe shall be as specified in item 2.10 of this section.

3.7 TRENCH EXCAVATION:

A. Trench excavation shall be made along the lines designated by the Engineer and to the depth necessary for laying the sewer to the required grade.

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- B. Sides of trenches shall be kept as nearly vertical as is allowable by the Occupational Safety and Health Administration. They shall be at least 12" and not more than 24" wider at the top of the pipe than the outside diameter of the pipe plus sheathing where it is necessary. Where pavement is to be cut. It shall be cut in advance of trenching 1' wider than the required width of the trench.
- C. Where soil conditions prohibit vertical walls, the trench width at the bottom and to 1' above the top of the pipe shall be as specified above with the remainder being held to the least possible width greater than that specified. Where soil conditions prevent ditch excavation without excessive widths, or where directed by the Engineer, wood or steel sheeting, as hereinafter specified, shall be driven to support the trench walls, or a suitably reinforced steel trench box shall be employed.
- D. Trench bottoms shall be hand graded to provide uniform and continuous bearing for the pipe along its entire length, with bell holes being dug for pipe bells. No ridges, sags, or undercutting will be allowed. Excess excavating below grade shall be backfilled at the Contractor's expense with suitable material which shall be thoroughly stamped.
- E. If approved by the Engineer and subject to suitable soil conditions, the trench may be excavated a few inches below the established subgrade and backfilled with selected material (from the excavation, if available) well compacted and so shaped as to give the pipes uniform bearing throughout their lengths at the established grade. Bell holes shall be dug to relieve the bells of load and to provide for completing the joints.
- F. Where the material at grade is unstable, soft, and incapable of supporting the pipe, the trench shall be excavated below grade, as directed by the Engineer, and refilled to grade with crushed stone or gravel to form a foundation for the pipe.
- G. When authorized by the Engineer, the Contractor shall dispose of material excavated from the trench that is unsuitable for backfill material. The Contractor shall provide the place select borrow material to replace unsuitable material for backfilling the trench as directed.
- H. Stone shall be compacted and graded to provide stable foundation and a uniform bearing for the pipe. Bell holes shall be provided as in other types of foundations.
- I. Should ground water be encountered in the bottom of the trench, causing the trench bottom to be unstable, the material, as directed by the Engineer, shall be excavated below grade sufficiently to allow a bed of crushed rock or gravel to be place in which to bed the pipe. The work shall be done as for unstable foundations The depth of cut below grade shall be only the minimum amount to accomplish the purpose, and shall be as directed by the Engineer.
- J. The Contractor shall furnish all machinery for pumping, bailing, and/or well pointing and shall pump, bail, or otherwise remove any water which may be found or shall accumulate in the trenches, and shall perform all work necessary to keep them clear of water while the pipe is being laid. The disposal of water after removal shall be satisfactory to the Engineer.
- K. Whenever necessary, the side of the trench shall be braced and rendered secure and either open or close sheathing used to the satisfaction of the Engineer; such sheathing and bracing to be left in place until the trench is refilled to a safe limit, not less than 2' above the top of the pipe. The top portion may be then cut off, but the lower portion shall remain undisturbed. In lieu of sheeting, suitable trench boxes may be employed. All sheeting, bracing, trench boxes, and trench construction methods shall conform to the latest Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970. No extra payment will be made for sheeting and bracing. Such cost shall be included in the cost of installing the pipe.

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- L. All existing water, sewer, and gas lines, buried electrical and telephone cable, and other known utilities intersecting the lines of construction, if requested by the Engineer, shall be uncovered by the Contractor at his expense and exposed to the Engineer at least 100' ahead of pipe laying operations of insure the correctness of grades. Existing utilities shown on the Plans are as accurately located as existing records and field surveys allow; however, the Contractor shall verify with the various utility companies before excavating and shall save harmless the Owner from any claims for damages as a result of this work.
- M. The Contractor shall at all times take necessary precautions in preventing gutters, catch basins, ditches and other drainage facilities from being clogged that might cause flooding conditions and damage to public or private properties.
- N. Rock Removal, Blasting
 - 1. In rock or other unyielding material, the excavation shall be made at least 6" below subgrade elevation. The trench shall be refilled with select material compacted in place as specified for ordinary excavation. Suitable material from excavation may be used, if available. If not, it shall be hauled in. Select material used in trench after rock excavation shall be included in the cost of rock excavation.
 - 2. Rock excavation for trenches and pits includes removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model No. 320 CL, and rated at not less than 138 HP flywheel power and 44,000- pound drawbar pull and equipped with a short stick and a 30-inch wide, tight tip radius rock bucket with rock teeth rated at 0.75 cubic yard (heaped) capacity.
 - a. Typical of materials classified as rock are boulders one-half (½) cubic yard or more in volume, solid rock, rock in ledges, and rock- hard cementitious aggregate deposits.
 - b. Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
 - c. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Owner's representative, and such information provided to the Engineer for approval. Such excavation will be paid on basis of Contract Conditions relative to changes in work.
 - 3. If rock is encountered, it shall be paid for at the unit price set forth in the Bid. Only solid rock as defined above requiring blasting or drilling for its removal will be classified as rock excavation. Allowance will be made for a width of the trench not in excess of 24" greater than the inside diameter of the pipe and a depth from the surface of the rock to be established subgrade of the pipeline but a minimum of a three foot trench width. Rock excavated in excess of these limits will not be paid for. The Engineer shall measure the amount of rock excavation to be classified as such before the trench is backfilled. No payment will be made for rock excavation which is backfilled before measurement by the Engineer.
 - 4. All blasting, where required, shall be done under the personal supervision of a man thoroughly skilled in this class of work. All necessary measures to protect life and property shall be taken. When in close proximity to buildings, transmission lines, telephone lines or other facilities, timber mats or other means of preventing damage from flying debris shall be used. Ample and suitable signals shall be given in proximity to the

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work before each blast, and flagmen shall be placed on all roads, beyond the danger zone, in every direction to warn traffic. All responsibility for damage rests on the Contractor.

- O. Upon completion of the backfilling and repair operation, all excess earth, broken pavement, rock, shoring and all left over materials and debris resulting from the Contractor's operations shall be removed from the work areas and disposed of by the Contractor. The Contractor shall provide his own disposal site. He shall comply with all State of North Carolina, County and Local regulations, rules and ordinances regarding the disposal of such material. All costs arising from the disposal of the material shall be borne by the Contractor at no additional cost to the Owner. The work areas and adjoining areas used by the Contractor shall be left clean and free of evidence resulting from the Contractor's presence.

3.8 PIPE INSTALLATION:

- A. Cast Iron Pipe
 - 1. Cast iron pipe in trench shall be laid as required for clay pipe. Joints in cast iron sewers in trench shall be completed with rubber gaskets in accordance with Federal Specification WW-P-421b.
- B. All sewer pipe shall be bedded as shown on standard sewer details and/or installed as called for above.
- C. All sanitary sewer pipe for pipe sizes up to 24" in diameter shall be assembled by using a bar and wood block to push the pipe into the "home" position or as per manufacturer's recommendations. The wood block shall be placed across the end of the pipe to act as a fulcrum point and protect the joint end during assembly. When absolutely necessary, the sanitary sewer pipe may be assembled by using the excavating equipment to apply pressure when pushing the pipe into the "home" position. When this method is used, a wood block shall be provided at the end of the pipe for protection of the end joint, and the pipe shall be held in a horizontal position with a "sling" and perfectly aligned with the preceding joints before assembly. The Contractor shall have the approval of the Engineer before assembling sanitary sewer pipe using the excavating equipment as a means of pushing the pipe into the "home" position. Notwithstanding the Engineer's approval, the Contractor shall be liable for any damage to the pipe as a result of using the excavation equipment. Pipe which is not true to alignment, or which shows settlement after laying, shall be taken up and relayed without extra compensation.
- D. Connecting to Existing Sewers
 - 1. Where shown on plans or directed by the Engineer, new sewers shall be connected to existing sewers by constructing a manhole or by cutting through the wall of an existing manhole. After construction of the new manhole, the old sewer shall be broken out and the inverts properly formed. For an existing manhole an opening shall be completely filled around the pipe with cement mortar and brick so as to be watertight. A channel shall then be formed over the manhole floor, or the floor cut through and the channel formed in it, as may be required by the grade. No additional payment will be made for this work. Temporary pipe work that may be required to handle sewage before turning it into the new line and/or bypass pumping shall be included in the cost of all other work.

3.9 MANHOLES:

- A. Precast Manholes
 - 1. Precast manholes shall be constructed as follows:

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- a. Precast base sections shall be installed on stabilized foundation so prepared to prevent settlement and misalignment. Pipe openings shall be exactly aligned to that of the pipe entering and leaving the manhole.
 2. Rubber ring joints or semi-rigid composition joints shall be carefully made in accordance with the manufacturer's instructions and generally in the following manner. Bells shall be wiped clean, be free of all dirt or other matter, and liberally lubricated for receiving the spigot ends. The gasket groove and gasket shall be well cleaned and lubricated prior to placing.
 3. Cement mortar joints shall be carefully made to the manufacturer's requirements. Grout shall be as stiff as possible to be consistent with good practice and all joints shall be well filled.
 4. Sewer pipe shall be placed in the openings provided in the base section and properly aligned and set to grade. They shall be firmly held in place by the flexible coupling and the base opening shall be filled with an expanding type grout well rammed into place.
- B. Manhole Drops: Manhole drops shall be supported and encased in brick work, and the backfill very thoroughly compacted. Should the trench for the upper sewer be excavated below grade beyond the brick work, enough cast iron pipe shall be used to provide a bearing of 2' on original ground.
- C. Manhole Tops: Manhole tops shall be set to the proper elevation as dictated by the location, or as directed by the Engineer. Care shall be exercised to set the tops at the proper elevation. Where manholes are located in streets or roads, the tops shall be set to conform to the finished grade of the roadway. Tops of manholes located in yards, roadway shoulders or populated areas shall be set flush with the ground elevation, unless directed otherwise by the Engineer. In cultivated fields, wooded areas and along outfall sewers the manhole tops shall be set approximately 1' above the elevation of the ground unless the line is subject to flooding or other hazards. In such instances manhole tops shall be set to the elevations given by the Engineer.
- 3.10 BACKFILLING:
- A. All trash, forms, debris, and other foreign material shall be cleared from around all pipes and structures before backfilling.
 - B. Backfilling around the pipe and to a depth of at least 1' above the top of pipe shall be placed by hand in layers of not over 6". Only select material containing no rocks or other objectionable material shall be used for this portion of the backfill. As fast as the material is placed, it shall be cut under the haunches of the pipe with a shovel and thoroughly compacted with mechanical tamps for the full width of the trench to provide support for the bottom and sides of the pipe. Filling shall be carried up evenly on both sides.
 - C. For PVC, Fiberglass, Open and Close Profile and HDPE Pipes – Backfill around the pipe and up to the spring line shall consist of clean granular aggregate. It shall be placed in such a manner as to completely fill all the voids under the pipe.
 - D. The balance of the backfill shall be placed and tamped to prevent excessive settlement in a manner satisfactory to the Engineer. If the trench backfill is located under miscellaneous paved areas, areas to be paved, or unpaved streets, the trench shall be backfilled with suitable material free from large stones or clods in 8" layers (loose measurement) and thoroughly tamped and compacted to 95% of maximum as established by AASHTO specification T99, method A, with mechanical tampers, so as to avoid future settlement. Where applicable, the compaction shall be acceptable to the Department of Transportation or Owner. For trenches located in streets and

highways trench backfilling shall be in accordance with the requirements of item 3.12 of this section, Cutting and Replacing Pavement.

- E. For pipe outside street limits, compaction shall be at least 90% of maximum as established by AASHTO Specification T99, Method A.
- F. Excess material shall be promptly removed from the site, and the pavement or road surface cleaned of objectionable material. The pavement and/or road surface shall be cleaned daily with a mechanical broom and/or washed if requested by the Engineer. The Contractor shall correct any future settlement within the guarantee period.
- G. In unpaved streets the top 6" of trench shall be filled with well compacted crusher-run stone. In paved areas the top of the trench shall be filled with the specified base for pavement, well mixed and compacted. Any settlement of backfill below finish grade shall be promptly corrected.
- H. On outfall lines and at other points where damage to the system or property will not occur, the backfill material more than 1' above the top of the pipe may be placed in 12" layers and compacted with mechanical tamps. The upper portion of the backfill, more than 5' above the pipe may be compacted by rolling with wheeled equipment. Excess material may be mounded on the trench. The Contractor will be responsible for all final subsidence of all trenches and shall leave the same flush with the original ground after all settlement has taken place. Trenches must be protected against scour due to surface drainage.
- I. Backfilling around manholes shall, in general, conform to requirements for backfilling trenches, except that no backfill shall be placed around manholes until all mortar has properly set, and backfilling shall be carried up symmetrically around structures.

3.11 DUST CONTROL:

- A. The Contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. The Contractor will not be directly compensated for any dust control measures necessary, as this work will be considered incidental to the work covered by the various contract items. The Contractor will provide dust control measures as directed by the Engineer.

3.12 CUTTING AND REPLACING PAVEMENT:

- A. Where pavement is to be cut for installation of pipe or other utilities, the Contractor shall cut it nearly in advance of trenching and shall replace the pavement with base and new pavement.
- B. In areas where roadway is to be patched pavement shall be neatly cut to a straight edge in advance of trenching with the method of cutting being subject to approval of the Engineer. Pavement shall be cut 12" wider than the excavated area on each side. Ragged and irregular edges will not be allowed and work completed with ragged edges shall be redone. Concrete pavement shall be sawed with suitable concrete saw cutting equipment.
- C. Trench backfilling shall be done in layers not over 6" thick and thoroughly compacted. Compaction shall be such as to prevent future settlement and shall be done by acceptable means, approved by the Engineer. Rolling with rubber-tired vehicles or track-type equipment will not be allowed. Compaction shall be at least 95% of maximum as established by AASHTO Specification T99, Method A.

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- D. Base for pavement shall be crusher run stone for all non-NC DOT maintained streets, HB binder for all secondary highways, and reinforced concrete for all primary highways. All base shall be placed in accordance with plan and/or encroachment permit details. Base width shall be as shown on the Plans and/or encroachment permits for various types of pavement cuts.
1. Crusher run stone shall conform to the requirements of Section 02231. It shall be well mixed and compacted by tamping and rolling. Compaction shall be to such degree as to preclude settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to top of ditch, to be cut out and replaced with base material at a later date, will not be allowed.
 2. Crusher run base for highway pavement and adjacent drives shall be 8" of stone, stabilized with 5% Portland Cement. It shall be thoroughly mixed prior to compacting.
 3. Crusher run base for non-highway pavement and drives shall be 8" of stone without the addition of cement.
 4. Binder base for secondary roads shall be a minimum of 6" HB binder conforming to specifications of the Department of Transportation.
 5. Concrete base shall consist of 8" of concrete, reinforced with #4 reinforcing steel bars placed at 8" on center in the transverse direction #4 tie bars in the longitudinal direction. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days. The design of the mix and source of supply shall be subject to approval of the Engineer.
- E. Pavement shall be replaced with the same type of pavement that exists prior to cutting and shall consist of either bituminous surface course (double treatment), 2" of hot plant mix asphaltic concrete, or 8" of Portland Cement concrete; all conforming to specifications of the Department of Transportation for each type.
1. Pavement shall be replaced with the same type of pavement that exists prior to cutting and shall consist of either bituminous surface course (double treatment), 2" of hot plant mix asphaltic concrete, or 8" of Portland Cement concrete; all conforming to specifications of the Department of Transportation for each type.
 2. For asphalt pavement or bituminous surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an acceptable asphalt prime coat just prior to placing new pavement.

3.13 REMOVING AND REPLACING SIDEWALK, OTHER ITEMS:

- A. Where pipe is to be placed under existing concrete sidewalk, the concrete shall be removed in construction units unless their length is more than 10', in which case the concrete shall be cut as specified in paragraph 3.11.2. of this section. The backfill shall be thoroughly compacted for the entire depth of the trench.
- B. The sidewalk shall be replaced with 3000 psi concrete, 4" thick, except for driveways where it shall be 6" thick. The concrete shall be placed monolithic and dressed off with a wooden float, brush and edging tool. Where pipe is to be placed under concrete walk, the Contractor may, with the permission of the Engineer, install the pipe by tunneling instead of removing and replacing the walk. If pipe is to be placed under curb and gutter, it shall be done by tunneling. No additional payment will be made therefor.
- C. The Contractor shall be responsible for removing and replacing items such as mail boxes, fences, shrubbery, walls, steps, and any other private ornamental items that are in direct conflict with the sewer line work. No additional payment will be made therefor.

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3.14 PIERS AND PROTECTION WORK:

- A. Concrete piers: Foundation for piers shall be adequate to support the intended load and will be subject to the Engineer's approval prior to pouring concrete. Concrete piers shall have a rubbed finish.
- B. Protection concrete shall be poured in such locations as shown on the plans or directed by the Engineer. It shall consist of one part Portland Cement, two parts sand and four parts crushed stone.

3.15 MISCELLANEOUS ITEMS:

- A. The Contractor shall be responsible for removing and replacing miscellaneous items in conflict with the sewer line work such as mail boxes., signs, fences, walls, shrubbery, private ornamental items, etc. Shrubby and plantings shall be preserved by proper root protection and watering until replanted. Tree limbs shall be protected where possible. Damaged trees shall be repaired with an approved tree dressing. No additional payment will be made for removing and replacing miscellaneous items.

3.16 REPAIRS TO DAMAGED SERVICES AND UTILITIES:

- A. Repairs to damaged services and utilities shall be promptly made at the Contractor's expense. The Contractor shall use every effort to avoid damaging or breaking water, sewer, gas, power, telephone or other utility services. Utility lines shall be properly supported across the pipe trench until backfilling is completed. Should damage occur, immediate action shall be initiated to effect satisfactory repairs. All repair work shall be satisfactory to the Engineer and owner of the damaged utility.

3.17 CLEANUP:

- A. All pipeline rights-of-way and pipework areas shall be cleaned up and left in satisfactory condition.
- B. Cleanup of work along highways or roads shall be made immediately upon completion of the backfill operation. Ditching and pipe laying shall be stopped at any time that cleanup work lags and shall not be resumed until cleanup progress is satisfactory to the Engineer. Final cleanup and condition of the work area shall be subject to the approval of the State Highway Representative, the Owner, and the Engineer.
- C. Cleanup of work for cross-country locations shall follow immediately upon the completion of any major part of the work or upon instructions by the Engineer. Topsoil shall be replaced on all areas disturbed by the pipeline work throughout the length of the sewer main, and to the full satisfaction of the property owner. Topsoil may be removed from the line of work and stockpiled for future use. It shall be carefully removed, stockpiled, protected, respread, dressed off, and the entire right- of-way left in condition acceptable to the Engineer and property owner. If topsoil is not stockpiled and protected, suitable, approved material from other sources shall be provided. Where the line is located on pasture land, grassed areas, or roadway shoulders, grass shall be replaced.

3.18 By-Pass Pumping:

- A. The Contractor shall provide pipe plugs, manhole dams, pumping equipment, and conduits as required to bypass sewage between manholes while a section of pipe is being repairs. The

bypass shall be maintained in continuous operation without undue disturbance to the inhabitants of the adjacent property until the line under repair may be returned to service.

- B. The Contractor shall provide barricades and warning signs and lights, and provide walkways and traffic ways at intersections over and/or around his conduits, and power to his pumps, as may be required, to provide for the movement of traffic and pedestrians in and around the area of the work. No street or intersection shall be blocked without notification to and permission of the Owner.
- C. Disposal of Surplus Material: Upon completion of the backfilling and repair operations, all excess earth, broken pavement, rock, shoring, and all left over materials and debris resulting from the Contractor's operations shall be removed from the work areas and disposed of by the Contractor. The Contractor shall provide his own disposal site. He shall comply with all State of North Carolina, County, and local regulations, rules and ordinances regarding the disposal of such material. All costs arising from the disposal of the material shall be borne by the Contractor at no additional cost to the Owner. The work areas and adjoining areas used by the Contractor shall be left clean and free of evidence resulting from the Contractors' presence.

END OF SECTION 02722

SECTION 02722 - SANITARY SEWERS Revision Date October 12, 2021
Town of Burgaw Standard Specifications

PART 1 - GENERAL

1.1 SCOPE

1. Work covered under this section of these specifications consists of the construction of force main lines and miscellaneous pipework, including all valves, fittings, and appurtenances. The scope of work shall be as detailed on the plans and itemized in the bid and shall include all material, equipment, labor and other items required for proper acceptable completion.

1.2 QUALITY ASSURANCE:

A. Standards:

1. American Society for Testing and Materials
 - a. ASTM D2241
 - b. ASTM D1784
 - c. ASTM D1598
 - d. ASTM D1599
 - e. ASTM D2152

- B. The Contractor shall retain the services of a testing laboratory to perform all compaction tests required at the project site. The testing laboratory shall be approved by the Engineer. In areas of fill and backfill, field density tests shall be performed in sufficient numbers to insure that the specified density is obtained. These tests shall be made and paid for by the Contractor in accordance with the testing allowance, except as follows.

1. Areas in which testing reveals compaction below the specified density shall be reworked, or removed and replaced by the Contractor until specified compaction is obtained. In the event results fail after reworking material, the Contractor shall be liable for retesting.
2. The Contractor shall be responsible for the cost of testing of borrow material which shall include standard density tests (Proctor curves).

1.3 SUBMITTALS:

- A. Shop drawings shall be submitted to the Engineer for the following items:

1. Gate Valves
2. Precast Manholes
3. Air Release Valves
4. Vacuum Valves
5. Plug Valves

- B. Manufacturer's certifications shall be submitted to the Engineer certifying that the following materials meet all requirements of the specifications:

1. Force Main Pipe
2. Force Main Pipe Fittings

- C. Mix designs for concrete and asphalt shall be submitted to the Engineer for approval, if requested by the Engineer.

PART 2 - PRODUCTS

2.1 ARTICLE

- A. P All material and appurtenances shall meet the following minimum standard requirements therefore. It shall be each manufacturer's responsibility to check the installation and to furnish material that will be full capable of performing its intended function.
- B. Pipe shall be of the type, size, class and diameter as hereinafter specified and called for by the Plans and/or Bid.
- C. Trench width for buried pipe design shall be considered as the outside diameter of the pipe plus 2', at the bottom and up to 1' above the top of the pipe.
- D. Buried pipe shall be designed for laying condition shown on construction drawing to withstand all internal pressures and external loads with a minimum depth to cover of 3', for pipelines 8" and smaller in diameter, and 3'-6" for lines 10" and larger in diameter, and greater depths of cover where required by the Plans, plus an H-20 live load in accordance with A.A.S.H.T.O. Specifications.
- E. Design pressure shall consist of 100 psi working pressure plus 100 psi surge allowance for force mains designated for Class 160 pipe and 150 psi working pressure plus 100 psi surge allowance for force mains designated for 150 psi working pressure.
- F. Pipe diameters shown or called for shall be the minimum net inside diameter of the pipe after any required lining is placed, with a maximum tolerance of 1/4" on the minus side, for sizes through 36" diameter.
- G. Pipe fittings shall be of the size, configuration and type called for by the plans. All fittings shall be of at least the same class as the pipe with which they are used. Ductile or gray cast iron fittings shall be used with all ductile iron, gray cast iron, and PVC pipe (4" or larger in diameter).
- H. Valves shall be of the type, size, and class required by the plans and all valves shall have standard mechanical joint ends, except where flanged or other type ends are specifically required. Valves, where required, shall be furnished with operating nuts, or handwheels as necessary, except in instances where other operating devices are specified or shown. All valves shall be of at least the same class of pipe with which they are used. A valve box shall be provided for each underground valve, except where shown differently on the plans. Concrete pipe vaults; or brick or precast manholes with crete pipe vaults; or brick or precast manholes with cast iron covers shall be provided for all air valves.

2.2 DUCTILE CAST IRON PIPE:

- A. Ductile cast iron pipe shall be centrifugally cast of ductile cast iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum elongation of 10% (Grade 60-42-10). It shall be designed, manufacture, and shall conform to the requirements of ANSI A21.51 (AWWA C151) Standards, for a minimum 150 psi operating pressure plus a minimum allowance of 100 psi for surge.

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- B. Nominal laying lengths shall be 18' or 20' nominal maximum of 20% of each size for each order being as much as 24" shorter than the nominal laying length and an additional 10% as much as 6" shorter than nominal laying length.
- C. Exterior pipe joints shall be mechanical or push joint type with retainer glands and flanged ends are required for interior piping.
- D. Dimensions shall conform to the requirements of ANSI A21.6, ANSI A21.8, ANSI A21.11, and WW-P-421 C, as applicable. Dimensions shall be gaged at sufficiently frequent intervals to assure dimensional control. Insides of sockets and outside of spigot ends shall be tested with circular gages.
- E. Wall thickness shall be determined for the design working pressing and depth of cover shown in accordance with ANSI requirements for each type.
- F. Each pipe shall be coated on the inside and outside with standard bituminous coating of either coal-tar or asphalt base approximately one mil thick. The coating shall be continuous, smooth, strongly adherent to the pipe and shall not become brittle from cold nor sticky from heat. As indicated on the plans, a special interior coating shall be used which shall be Protecto 401 ceramic lining as manufactured by U.S. Pipe, Sewper Coat as manufactured by Lafarge Calcium Aluminum, or equal. All linings and coatings shall be per manufacturer's specifications and conform to ANSI/AWWA C151/A21.51.
- G. Each pipe shall be weighed prior to placing of the inside lining. Weight nominal thickness, sampling period, and class of pipe shall be shown on each pipe.
- H. The manufacturer's year of production and the letters DI or DUCTILE shall be clear and legible and on, or near, the bell end.

2.3 POLYVINYL CHLORIDE PIPE:

- A. PVC pipe shall be rigid polyvinyl chloride with integrally formed, factory fabricated for rubber ring type joints. It shall be suitable for all conditions imposed by Plan locations and for a minimum working pressure of 150 psi, plus 100 psi surge allowance at 73°F. Pipe shall be Type 1, Grade 1, made from clear virgin material and shall conform to all requirements of AWWA Specifications C-900, Class 150. All pipe shall bear the manufacturer's name, specification, and class of pipe. Each length of pipe shall be 20' "1", or 38' "1" except that, random lengths may be furnished for special connections and other special uses.
- B. Provisions must be made for expansion and contraction at each joint, through the rubber gasket and pipe bell. Laying lengths shall be 20'-1", or 38'-1" except that, random lengths may be furnished for special connections and other special uses.

2.4 DUCTILE CAST IRON FITTINGS:

- A. Ductile cast iron fittings shall conform to the requirements of ANSI Specification A21.10, with mechanical joint ends conforming to ANSI Specification A339, Grade 80-60-3. All fittings shall have exterior and interior coatings as required for pipe. Where flanged ends may be required, flanges shall conform to applicable requirements of ANSI B16.1 and ANSI B16b.

2.5 PVC FITTINGS:

- A. PVC fittings and adapters shall conform to the same requirements as for pipe and shall be the same class as the pipe.

2.6 JOINT MATERIAL:

- A. Gaskets for pipe and fittings shall be continuous ring of rubber material compounded to resist deterioration and of a texture to assure a permanent and watertight seal. They shall have smooth surfaces, free from pitting, blisters, porosity or any other defects. Gaskets shall conform to the requirements of AWWA Specification C301 and Federal Specification WW-P-421b.
- B. Gasket lubricant shall be a potable hydrogenated vegetable oil, insoluble in cold water, non-toxic and shall not support the growth of bacteria. It shall contain no deleterious ingredients and shall have no deteriorating effects on the gaskets. The lubricant shall be semi-paste, easily applicable, readily adherent to the inside of the bell and shall remain in a usable state throughout the range of temperature in which pipe is normally installed. Lubricant shall be delivered to the job site in unopened containers bearing the manufacturer's name and trade name or trademark.

2.7 RESTRAINED JOINT PIPE AND FITTINGS:

- A. Restrained joint pipe and fittings shall be ductile iron manufactured in accordance with AWWA C151 and C153. The restraining method shall be by a snap in place flexing restraining ring at the joint. The pipe and fittings shall be American Flex- Ring, Griffin Snap-Lok, US, T.R. Flex, or equal. All pipe and fittings shall have exterior and interior coatings as herein before specified.

2.8 GATE VALVES:

- A. Gate valves, larger than 2" shall be iron body, resilient seat non-rising stem and provided with suitable stem seals. They shall comply with AWWA C-509, designed for a minimum operating pressure of 150 psi. Gate valve shall by Clow or approved equal.
- B. Gate valves 2" and smaller shall be standard all brass valves with inside screw, rising stem and handwheel operator, suitable for 125 psi. Gate valve shall by Clow or approved equal.

2.9 PLUG VALVES:

- A. Plug valves shall be of the non-lubricated, eccentric type with resilient faced plugs, with flanged ends for installation within structures and mechanical joint ends for buried service. Port areas shall be at least 80% of full pipe area for pipes 6" to 16" in diameter and 70% of full pipe area for valves larger than 16" diameter. Valves smaller than 6" in diameter shall have 100% full pipe area. Bodies shall be semi-steel, gray cast iron, or ductile iron. Seats in 3" and larger valves shall have a welded in overlay of not less than 90% pure nickel on all surfaces containing the plug face. Valves shall have stainless steel permanently lubricated upper and lower plug stem bushings. All 4" and larger valves shall be of the bolted bonnet design. All nuts, bolts, springs, and washers shall be cadmium plated.
- B. Plug valves 4" and smaller for non-buried service shall be equipped with (true) manual gear type operators with position indicators. Plug valves 6" and larger for non-buried service and all sizes for buried services shall be equipped with manual gear actuators. All gearing shall be enclosed, submersible with seals provided on all shafts to prevent entry of water into actuator. All shaft bearing shall be furnished with permanently lubricated bronze bearing bushings. Actuators of nonburied service shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Valve packing adjustment shall be accessible without disassembly of the actuator. Valves for non-buried services shall be furnished with a handwheel, except valves mounted inaccessibly high shall be provided with chain operators.

Plug valves for buried service shall have gear operators and shall be provided with nut operator and extension stem of suitable length.

- C. Valves shall be as manufactured by Clow or approved equal. Actuators shall be as manufactured by Clow, Dezurik, Keystone, Kennedy, or equal.

2.10 CHECK VALVES:

- A. Standard check valves shall be iron body, bronze, mounted, full opening external lever weight loaded, 125 lb. ANSI Standard flanged, and suitable for at least 150 psi pressure. Check valves shall have two ½" threaded taps on the side upstream and downstream from the clapper. A ½" galvanized nipple and ½" bronze gate valve shall be installed in each tap. Valves shall be as manufactured by Clow or approved equal.

2.11 CHECK VALVES 2" AND SMALLER:

- A. Check valves 2" and smaller for sewage service shall be all bronze, swing check type with threaded connections, rated 125 psi. Valves shall be as manufactured by Clow or approved equal.

2.12 CUSHION CHECK VALVE:

- A. Cushion check valves shall be controlled closing swing check valves. Valve body, cover, and lever shall be heavy duty cast iron, ASTM A126-B. Disc arm shall be cast steel keyed to the hinge shaft. Hinge shaft shall be 18-8 stainless steel, sized to withstand a complete hydraulic unbalanced pressure of 125 psi on the valve disc. A single oil-filled cushioning device shall be allowed for field adjustment of the valve closing speed at the final portion of the disc travel. Valve shall have ANSI 125 pound flanged connections. Valves shall be rated for 150 psi working pressure and 100 psi surge pressure. Valves shall be as manufactured by Clow or approved equal.

2.13 BALL CHECK VALVES:

- A. Ball check valves shall be high density PVC with threaded connections or ductile iron body with flanged connection rated 125 psi and 150°F as required. Ball shall be hollow steel and coated to prevent wear and deterioration. Valve shall be suitable for mounting in either horizontal or vertical direction. Valves shall be as manufactured by Clow or approved equal.

2.14 VALVE BOXES:

- A. Valve boxes shall be of cast iron, three-piece, screw type with covers and bases. They shall be of suitable size for the valve with which they are used and fully adjustable for depth of setting, extension pieces being furnished where necessary. Drop type covers shall be provided for each box with the proper work designating the valve service cast into its top surface. Oval type bases shall be provided and shall be so designed to fully support the box without weight of the box and/or superimposed load being transmitted to any part of the valve or adjacent pipe on either side.

2.15 CONCRETE:

- A. Concrete for protection and a thrust blocks shall be composed of Portland Cement, sand, coarse aggregate, water and such admixtures as may be allowed, in such proportions as to provide in

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minimum compressive strength of 3,000 psi. The source of concrete and mix design shall be approved by the Engineer to use.

2.16 CRUSHED STONE:

- A. Crushed stone for pipe bedding shall conform to ASTM C33, size no. 67 with a range of ¼" to 1.

2.17 MANHOLE MATERIAL:

- A. Manhole material shall precast concrete in accordance with the following requirements. All material shall be approved by the Engineer prior to use.
- B. Precast concrete manholes shall consist of precast reinforced concrete sections, a conical or flat top section as required, and a base section conforming in general to the details shown on the Plans. Precast manhole sections shall be manufactured in accordance with ASTM Specification C478. The minimum compressive strength of the concrete for all sections shall be 4,000 psi. The maximum allowable absorption of the concrete shall not exceed 8% of the dry weight.
- C. The interior surfaces of manholes shall be factory coated as indicated in the details.

2.18 MASONRY CEMENT:

- A. Masonry cement shall be of best grade, conforming to ASTM Specification C91, Type II, of a brand approved by the Engineer. It shall be newly manufactured, well housed, and kept dry and protected at all times.

2.19 CASTINGS AND STEPS:

- A. Castings and steps shall be provided for each manhole. Frames, covers, and stops shall be of cast iron of superior quality, tough and even texture, and of not less than 40% pig. They shall be clear of blow holes, holes and cracks, or other defects; properly finished and bituminous coated while hot.
- B. Manhole covers, frames, and steps shall conform to the details for each type manhole on the Plans, or to similar plans differing in details, but of equally good design; provided such castings are approved by the Engineer prior to use. Covers and frames shall be machined to provide plane, smooth surfaces for uniform seating and interchangeability of covers. Rings and covers that provide imperfect seating will be rejected. All covers and frames shall be suitable for traffic service. Minimum opening shall be 22" in diameter; minimum weight of cover shall be 120 lbs.; and minimum weight of frame shall be 230 lbs.
- C. Special frames and covers shall be provided for sealing manholes water tight at location shown on the Plans. These frames and covers shall conform to the above specifications and shall be provided with a one piece rubber gasket seated into the manhole frame. Covers shall be secured with 4 minimum ½" lug bolts. Such frames and covers shall be manufactured by Neenah Foundry, Dewey Brothers, Inc., or equal.

2.20 COMBINATION AIR/VACUUM AND AIR RELEASE VALVES:

- A. Air release valves shall be the long stem and body type designed to keep the valve operating mechanism as free from contract with the sewage as possible. Valves shall have 2" threaded inlet, with 1" blow off connection with 1" blow off valve (gate valve), ½" back flushing attachments with ½" outlet. Outlet and back flushing connections shall be quick couplings.

Valve shall have a minimum of ¼" diameter orifice. Valve body shall be cast iron; mechanism and seat, bronze; lever pins, stainless steel; and float, stainless steel. Valves shall be suitable for 150 psi working pressure. Valves shall be as manufactured by the Multiplex Manufacturing Company, the Valve and Primer Company, Val-Matic Manufacturing Corporation, or equal.

- B. Air and vacuum sewer valves shall be the long stem and body type designed to keep the valve operating mechanism as free from contact with the sewage as possible. Valves shall have 2" threaded inlet; 1" blow off connection with 1" blow off valve (gate valve); and ½" back flushing attachments with ½" outlet. Outlet and back flushing connections shall be quick couplings. Valve shall have a minimum of 1" diameter orifice. Valve body shall be cast iron. Valve and float shall be stainless steel. Valves shall be suitable for 150 psi working pressure. Valves shall be as manufactured by the Multiplex Manufacturing Company, the Valve and Primer Company, Val- Matic Manufacturing Corporation, or equal.

2.21 STEEL ENCASUREMENT PIPE:

- A. Steel encasement pipe shall bituminous coated inside and outside. Bituminous coating shall be 6 mil. minimum thickness. Steel encasement pipe shall have a minimum thickness as indicated in the plans for bores under highways and shall meet ASTM Specifications A252 with a minimum yield strength of 35,000 psi.

PART 3 - MATERIAL TESTING

Material shall be tested in accordance with the General Conditions of these Specifications and the following:

3.1 PIPE:

- A. Each joint of pipe shall be subjected to and successfully meet hydrostatic proof test in accordance with ANSI requirements for each type. Cast iron pipe shall be tested prior to lining. Certified test results shall be furnished to the Engineer, for each shipment of pipe.
- B. PVC pipe shall be given the Quick Burst Test in accordance with ASTM D1599; Sustained Pressure Test in accordance with ASTM D1598; Acetone Immersion Test in accordance with ASTM D2152; Vise Flattening Test (compress 2" long ring in less than one minute to 100% flattening without evident of splitting or shattering); and Drop Impact Test C. (single impact load from free falling missile having a ½" diameter rounded, 1" long nose compacted on a 6" long horizontal specimen. No shattering or splitting shall occur at the following energies 1½" nominal size - 24 ft-lb, 2" - 57 ft-lb, 4" - 86 ft-lb, and 6" 100 ft-lb).

3.2 PIPE FITTINGS:

- A. Pipe fittings shall be subject to inspection and testing in accordance with standard manufacturing practice.

3.3 GASKETS:

- A. Gaskets shall be tested, if required, in accordance with Section 3-4 of ANSI A21.11.

3.4 VALVES:

- A. Valves shall be tested to double the design working pressure and test result submitted to the Engineer upon request.

3.5 OTHER MATERIAL:

- A. Other material shall be subject to such testing as the Engineer may require should its acceptability be questioned.

PART 4 - CONSTRUCTION PROCEDURES

All items of material and appurtenances shall be installed in accordance with best practice, manufacturer's instructions and to the following specifications or the Engineer's direction:

4.1 LOCATION:

- A. Pipework shall be installed at the locations shown on the plans and to the position, alignment and grade shown thereon. Prior to beginning work at any location, the Contractor shall consult with the Engineer and Owner to determine that all rights-of-way, permits, or other legalities are in order. He shall familiarize himself with all conditions and/or limitations of such rights-of-way or permits and shall fully comply with all such requirements. All work shall be confined to rights- of-way or permit limits and any encroachment beyond such limits shall be the Contractor's liability.

4.2 CLEARING AND GRUBBING:

- A. Clearing and grubbing, where required, shall be done prior to beginning of pipe installation. It shall be done in accordance with applicable portions of items of General Conditions and the following:
- B. The Contractor shall consult with the Owner and Engineer prior to starting clearing and a full understanding is to be reached as to procedure. The Contractor shall then conduct clearing and grubbing operations in strict accordance with these agreements.
- C. Clearing of trees and brush along the pipeline shall be carefully done so that no damage will occur outside of the limits of the right-of-way. Trees and brush must be cut by hand and trees felled within the right-of-way limits.
- D. Brush, laps, roots, etc., shall be disposed off-site in a manner approved by the Engineer. Burning of trees, brush and debris will not be permitted.
- E. Grubbing of stumps that are in the way of construction shall be done in any convenient manner which will not cause damage to remaining trees or adjacent property. Stumps shall be disposed as for brush or laps above.
- F. Limits of the pipe-laying operation shall be confined to the right-of-way and easements. The width of clearing shall be held to a minimum and in no case wider than the right-of-way or easement.

4.3 WORK ON HIGHWAY RIGHT-OF-WAY:

- A. The Contractor shall not begin work on any property of the Department of Transportation until he has secured necessary permits and obtained a copy of the R.O.W. encroachment contract from the Owner. He shall conform to all requirements of the Department of Transportation; or its authorized representative in the prosecution of this portion of the work. It shall be the responsibility of each Bidder to contact the local DOT representative and to determine the exact requirements for work to be done. Requirements shall include, but are not limited to the following:

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1. Where a pipeline crosses under a highway, it shall be installed either by open cut in tunnel or in encasement under the highway. Materials and method of crossing shall be as indicated on the plans for each crossing. Where pipe is installed by open cut at least one full lane for traffic shall be kept open and clear at all times.
 2. The Contractor shall provide full-time flagmen, with appropriate red flags, at all times when work is in progress along highways.
 3. Necessary warning and descriptive signs shall be provided and placed at each end of the working area while work is in progress along highways. These signs shall be well tended and shall be placed at sufficient distances from the site of the work so that ample warning is given to approaching traffic. Signs shall be adequately lighted at night and meet Department of Transportation requirements.
 4. The Contractor shall keep all streets open to traffic at all times unless permitted otherwise by the Engineer or Department of Transportation as applicable. The Contractor shall provide, place, and maintain temporary traffic control devices as directed by the Engineer or Department of Transportation. The latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways as prepared by the National Joint Committee on Uniform Traffic Control Devices shall be used as a guide in the placement of devices and all devices shall meet the requirements of said manual. The removal of road signs shall be done in accordance with and subject to the approval of the North Carolina Department of Transportation. Temporary signs shall be furnished and installed by the Contractor as necessary and as required. All Regulatory Signs shall be replaced immediately following backfilling or at the end of each day, whichever occurs first.
 5. Where pipe is installed in open cut across a highway, the cut shall be immediately backfilled and all work of repairing the pavement completed immediately. Any subsequent settlement shall be immediately corrected and repaired.
 6. Where pavement is cut and replaced, the Contractor shall cut the edges to a straight and even line before repairing the pavement. No ragged edges will be allowed or accepted.
 7. Where asphalt pavement is cut, the entire area to be repaired shall be primed with an asphalt prime coat, acceptable to the Department of Transportation, before the pavement is replaced.
 8. When required, the Contractor shall furnish to the Department of Transportation a 100% Performance Bond for the amount of paving to be cut and replaced along highways. Bond is required in North Carolina.
 9. Unless otherwise indicated, no excavated material shall be placed on the pavement side of the ditch, along State highways. The least possible amount of ditch will be left open when work is not in progress and equipment shall be removed from the pavement and shoulders during shut-down periods.
- B. Shoulders of roadways shall be left in good, acceptable condition and all topsoil and grass that is disturbed shall be replaced. Grassing shall include seeding, fertilizing, and mulching to conform with Department of Transportation requirements.
- C. The Contractor shall pay the cost of all Department of Transportation inspector's time, if required on the job.
- 4.4 WORK ON RAILROAD RIGHT-OF-WAY:
- A. The Contractor shall not begin work on any property of the railroad until he has secured necessary permits. He shall conform to all requirements of the railroad, or its authorized

representatives, in the prosecution of this portion of the work, including but not limited to the following:

1. Where a pipeline crosses under a railroad, the work shall be done in accordance with requirements of the Railway Company. Pipe shall be installed by boring and jacking (or open cut as designated). Excavation shall be done ahead of the pipe. The encasement must be kept on accurate line and slightly below grade. A tolerance of ½% will be allowed on short lines in good soil and not over 1% in any case.

B. The Contractor shall furnish the Railway Company the following:

1. Certificate of Workers' Compensation or Employer's Liability Insurance according to the laws of the State.
2. Certificate of the Contractor's Public Liability Insurance, to protect the contractor and subcontractor for loss of life or injury to persons in an amount not less than \$1,000,000 for any one person and not less than \$1,000,000 for any accident, and for property loss or damage in an amount not less than \$1,000,000 for any one accident and not less than \$1,000,000 for any accident, and for property loss or damage in an amount not less than \$1,000,000 for any one accident and not less than \$1,000,000 aggregate or as required by the Railroad Company.
3. The original policy of Railroad Protective Liability Insurance naming the Railway Company as the insured for loss of life or injury to persons in an amount not less than \$2,000,000 for one person, and not less than \$2,000,000 for any accident and for property loss or damage in an amount not less than \$2,000,000 for any one accident and not less than \$2,000,000 aggregate or as required by the Railroad Company. The Railroad Protective Liability Policy should show the location and description of work and name of Owner for whom the work is done.
4. The Contractor shall also pay the cost of flagmen or other expenses of the railroad in protecting traffic. He shall notify the railroad of the time that the work will be done and shall not begin work until authorized by railroad officials.

4.5 BORED ENCASUREMENT INSTALLATION:

- A. Encasement pipe which is dry bored under highways and railroads for installation of force mains shall be installed at the locations, to the gradients, and within the tolerances (if any), as shown on the plans. In event the encasement is installed off grade or seriously out of line, then another encasement pipe will be dry bored as close as practical to the original pipe with no additional compensation allowed therefor. The original encasement must be sealed with a watertight concrete plug (min. 3' deep) at each end.
- B. Any additional pipe or other work required for realignment of the force main with an alternate encasement location which was required due to improper gradient or misalignment in the original installation, shall be completed at the Contractor's expense.
- C. In event an obstruction is encountered during encasement boring operations which cannot be overcome, a second encasement shall be bored at a location designated by the Engineer. No additional compensation will be allowed for the second encasement installation. In event an obstruction is encountered in the second installation, at the direction of the Engineer, a third attempt shall be made to complete the encasement installation. Consideration will be given for additional compensation in event a third installation attempt is required. All abandoned encasement pipes shall be sealed as specified in paragraph 4.5.A above.

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- D. Pipelines installed through steel encasement shall meet specifications herein described and all Department of Transportation or Railroad specifications and guidelines for installing pipelines through steel encasement pipe. Upon insertion of the pipeline through the encasement pipe, the ends of the encasement pipe shall be sealed with brick and mortar. Brick and mortar shall be as herein specified, and the seal shall be such to withstand hydrostatic pressure from ground water and all backfill loads. Contractor shall provide means to prevent water line from floating within the encasement pipe. Grouting procedure will not be allowed.
- E. Casing pipe and joints shall be of leakproof construction, capable of withstanding railway or traffic loading. The diameter of the casing pipe shall be at least 2" greater than the largest outside diameter of the carrier pipe, joints, or couplings for carrier pipe less than 6" in diameter and at least 4" greater for carrier pipe, 6" in diameter and greater, unless indicated differently on drawings. Further, the casing pipe shall be of great enough diameter to allow carrier pipe to be removed subsequently without disturbing the case pipe and immediate areas.
- F. Steel encasement pipe shall be as specified in item 2.23 of this section.

4.6 TRENCH EXCAVATION:

- A. Trenches for pipe shall be dug true to line and grade and to the following requirements. Depth of cover shall not be less than 3'-6" for pipe 10" and larger in diameter, measured to the top of pipe, unless shown differently on the profile or authorized by the Engineer.
- B. Sides of trenches shall be kept as nearly vertical as possible. They shall be at least 12", and not more than 24" wider at the top of the pipe than wide diameter of the pipe, plus sheathing where it is necessary. Where paving is to be cut, it shall be cut in advance of trenching 1' wider than the specified width of the trench.
- C. Where soil conditions prohibit vertical walls, the trench width at the bottom and to 1' above the top of the pipe shall be as specified above with the remainder being held to the least possible width greater than that specified. Where soil conditions prevent ditch excavation without excessive widths, or where directed by the Engineer, wood or steel sheeting, as hereinafter specified, shall be driven to support the trench walls, or a suitably reinforced steel trench box shall be employed.
- D. Trench bottoms shall be hand graded to provide uniform and continuous bearing for the pipe along its entire length, with bell holes being dug for pipe bells. No ridges, sags or undercutting will be allowed.
- E. If approved by the Engineer and subject to suitable solid conditions, the trench may be excavated a few inches below the established subgrade and backfilled with selected materials (from the excavation, if available) well compacted and so shaped as to give the pipes uniform bearing throughout their lengths at the established grade. Bell holes shall be dug to relieve the bells of load and to provide for completing the joints.
- F. Where the material at grade is unstable, soft, and incapable of supporting the pipe, the trench shall be excavated below grade, as directed by the Engineer, and refilled to grade with crusher-run stone or gravel so as to form a firm foundation for the pipe. None shall be compacted and graded so as to provide stable foundation and a uniform bearing for the pipe. Bell holes shall be provided as in other types of foundations.
- G. Where the material excavated from the trench is unsuitable for backfill material, it shall be hauled off and disposed of and selected material hauled in for backfilling the trench.

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- H. Should ground water be encountered in the bottom of the trench, causing the trench bottom to be unstable the material, as directed by the Engineer shall be excavated below grade sufficiently to allow a bed of crushed rock or gravel to be placed in which to bed the pipe. The work shall be done as for unstable foundations. The depth of cut below grade shall be only the minimum amount to accomplish the purpose, and shall be as directed by the Engineer.
- I. The Contractor shall furnish all machinery for pumping, bailing, and/or pointing and shall pump, bail, or otherwise remove any water which may be found or shall accumulate in the trenches, and shall perform all work necessary to keep them clear of water while the pipe is being laid. The disposal of water after removal shall be satisfactory to the Engineer.
- J. Whenever necessary, the side of the trench shall be braced and rendered secure and either open or close sheeting used to the satisfaction of the Engineer; such sheeting and bracing to be left in place until the trench is refilled to a safe limit, not less than 2' above the top of the pipe. The top portion may then be cut off, but the lower portion shall remain undisturbed. In lieu of sheeting, suitable trench boxes may be employed. All sheeting, bracing, trench boxes, and trench construction methods shall conform to the latest Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970. No extra payment will be made for sheeting and bracing. Such cost shall be included in the cost of installing the pipe.
- K. In rock or other unyielding material, the excavation shall be made at least 6" below subgrade elevation. The trench shall be refilled with select material compacted in place as specified for ordinary excavation. Suitable material from excavation may be used, if available. If not, it shall be hauled in.
 - 1. If rock is encountered, it shall be paid for at the unit price set forth in the Bid. Only solid rock as defined above requiring blasting or drilling for its removal will be classified as rock excavation. Allowance will be made for a width of the trench not in excess of 24" greater than the inside diameter of the pipe and a depth from the surface of the rock to be established subgrade of the pipeline but a minimum of a three foot trench width. Rock excavated in excess of these limits will not be paid for. The Engineer shall measure the amount of rock excavation to be classified as such before the trench is backfilled. No payment will be made for rock excavation which is backfilled before measurement by the Engineer.
- L. All blasting, where required, shall be done under the personal supervision of a man thoroughly skilled in this class of work. All necessary measures to protect life and property shall be taken. Where in close proximity to building, transmission lines, telephone lines, or other facilities, timber mats or other means of preventing damage from flying debris shall be used. Ample and suitable signals shall be given in proximity to work before each blast, and flagmen shall be placed on all roads, beyond the danger zone, in every direction to warn traffic. All responsibility for damage rests on the Contractor.
- M. All existing water, sewer, and gas lines, buried electrical and telephone cable, and other known utilities intersecting the lines of construction, if requested by the Engineer, shall be uncovered by the Contractor at his expense and exposed to the Engineer at least 100' ahead of pipe laying operations to insure the correctness of grades. Existing utilities shown on the plans area as accurately located as existing records and field surveys allow; however, the Contractor shall verify with the various companies before excavating and shall save harmless the Owner from any claims for damages as a result of his work.

- N. The Contractor shall at all time take necessary precautions in preventing gutters, catch basins, ditches and other drainage facilities from being clogged that might cause flooding conditions and damage to public or private properties.
- O. During the course of pipeline construction, benching, early seeding or grass cover, and whatever means necessary shall be carried out to prevent siltation and bank erosion.

4.7 INSTALLATION OF FORCE MAINS AND APPURTENANCES:

- A. The Contractor shall haul the pipe and appurtenances to the site of work and distribute them neatly along the trench prior to laying. The pipe shall be carefully handled to prevent damage, mechanical hoists or other approved methods being used in the handling. Depth of cover shall not be less than 3'-0" for pipe up to 8" in diameter or 3'-6" for pipes 10" and larger in diameter, measured to the top of pipe, except where shown differently on a profile or specifically authorized by the Engineer.
- B. Pipe and appurtenances shall be kept clean and open ends securely plugged when pipe laying is not in progress. The inside of pipe and bell and spigots shall be thoroughly inspected and cleaned prior to lowering into the ditch and care shall be exercised after the pipe is in place to prevent dirt or other extraneous material from getting into the pipe or bells and into the spigot.
- C. Spigots shall be fully seated in the bells and the pipe shall be uniformly bedded on the bottom of the trench for its entire length with bells lying in previously dug bell holes sufficiently large to allow proper bedding and jointing. Fittings, valves and other appurtenances shall be located where shown on the plans or directed by the Engineer, with the pipe being cut where necessary. After jointing, a reasonable amount of deflection may be made in the joint. Such deflection shall not exceed the allowable amount specified by the manufacturer for each size of pipe.
- D. Pipe shall be laid in accordance with the manufacturer's instructions, applicable portions of AWWA Specification C600, and the following:
- E. For mechanical joint pipe, Type II, the rubber rings shall be properly lubricated and the spigots and bells cleaned before assembling the joint. Nuts of bolted joints shall be tightened with special torque limiting wrenches set to provide the proper strain on the bolt, and all nuts tightened to that limit.
- F. Rubber ring joints, Type III, shall be assembled in accordance with the manufacturer's instructions. The bell and spigot shall be absolutely clean prior to seating of the gasket. The gasket shall be wiped clean, flexed and properly inserted into the socket and seated evenly and properly. Care shall be taken to eliminate any bulges which might interfere with the proper entry of the spigot. A thin film of lubricants, shall be applied to the inside surface of the gasket. The spigot shall then be completed by forcing the spigot into the bell until it makes contact with the bottom of the socket. This shall be done by use of pipe jack and assembly, or other methods as approved by the Engineer.
- G. Fittings shall be installed where shown on the plans or directed by the Engineer. They shall be handled and installed in the same manner as the pipe and all shall be well blocked as hereinafter specified.
- H. Concrete for blocking and protection shall be poured in accordance with the following requirements. All fittings, bends, dead ends, etc., shall be acceptably blocked with concrete having bearing on undisturbed earth in the side and/or bottom of the trench. Bearing area shall be equal to that shown on the plans and greater if deemed necessary by the Engineer. No concrete shall be poured or splattered on fittings bells, glands, or bolts.

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- I. Where shown on the plans, or directed by the Engineer, concrete supports, walls, or other protective work shall be constructed.
- J. Contractor shall take elevation shots every 100 feet on the installed force main pipe along the entire route to ensure positive and uniform grades to each air release valve. The elevations shall be recorded by the Contractor with a record provided to the Engineer.

4.8 BACKFILLING OF TRENCHES:

- A. Backfilling of trenches shall be completed after the installation of each section of pipe laying to the satisfaction of the Engineer.
- B. Backfilling around the pipe and to a depth of at least 1' above the top of pipe shall be placed by hand in layers of not over 6". Only select material containing no rock or other objectionable material shall be used for this portion of the backfill. As fast as the material is place, it shall be cut under the haunches of the pipe with a shovel and thoroughly compacted with mechanical tamps for the full width of the trench to provide support for the bottom and sides of the pipe. Filling shall be carried up evenly on both sides.
- C. The balance of the backfill shall be placed and tamped to prevent excessive settlement in a manner satisfactory to the Engineer. If the trench backfill is located under miscellaneous paved areas, areas to be paved, or unpaved streets, the trench shall be backfilled with suitable material free from large stones or clods in 8" layers (loose measurement) and thoroughly tamped and compacted to 95% of maximum as established by AASHTO Specification T99, Method A, with mechanical tampers, so as to avoid future settlement. Where applicable, the compaction shall be acceptable to the Department of Transportation or Owner.
- D. For pipe outside street limits, compaction shall be at least 90% maximum as established by AASHTO Specification T99, Method A.
- E. Excess material shall be promptly removed from the site, and the pavement or roads surface cleaned of objectionable material. The pavement and/or road surface shall be cleaned daily with a mechanical broom and/or washed if requested by the Engineer. The Contractor shall correct any future settlement within the guarantee period.
- F. In unpaved streets, the top 6" of the trench shall be filled with well compacted crusher-run stone. In paved areas, the top of the trench shall be filled with the specified base for pavement, well mixed and compacted. Any settlement of backfill below finish grade shall be promptly corrected.
- G. On cross country lines and at other points where damage to the system or property will not occur, the backfill material more than 1' above the top of the pipe may be placed in 12" layers and compacted with mechanical tamps. The upper portion of the backfill, more than 5' above the pipe, may be compacted by following with wheeled equipment. Excess material may be mounded on the trench. The Contractor will be responsible for all final subsidence of all trenches and shall leave the same flush with the original ground after all settlement has taken place. Trenches must be protected against scour due to surface drainage.
- H. Backfilling around manholes shall, in general, conform to requirements for backfilling trenches, except that no backfill shall be placed around manholes until all mortar has properly set and backfilling shall be carried up symmetrically around structures.

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4.9 CUTTING AND REPLACING PAVEMENT:

- A. Where pavement is to be cut for installation of pipe or other utilities, the Contractor shall cut it neatly in advance of trenching and shall replace the pavement with base and new pavement.
- B. All pavement shall be neatly cut to a straight edge in advance of trenching with the method of cutting being subject to approval of the Engineer. Pavement shall be cut 12" wider than the excavated area on each side. Ragged or irregular edges will not be allowed and work completed with barred edges shall be redone. Concrete pavement shall be sawed with suitable concrete saw cutting equipment.
- C. Trench backfilling shall be done in layers not over 6" thick and thoroughly compacted. Compaction shall be such as to prevent future settlement and shall be done by acceptable means, approved by the Engineer. Rolling with rubber-tired vehicles or track-type equipment will not be allowed. Compaction shall be at least 95% of maximum as established by AASHTO Specification T99, Method A.
- D. Base for pavement shall be crusher run stone for all non-NCDOT maintained streets, HB binder for all secondary highways, and reinforced concrete for all primary highways. All base shall be placed in accordance with plan and/or encroachment permit details. Base width shall be shown on the plans and/or encroachment permits for various types of pavement cuts.
 - 1. Crusher run stone shall conform to the requirements of North Carolina Department of Transportation. It shall be well mixed and compacted by tamping and rolling. Compaction shall be to such degree as to preclude settlement. Crusher run base material shall be placed at the same time that the trench is backfilled. Backfilling to top of ditch, to be cut out and replaced with base material at a later date, will not be allowed.
 - 2. Crusher run base for highway pavement and adjacent drives shall be 8" of stone, stabilized with 5% Portland Cement. It shall be thoroughly mixed prior to compacting.
 - 3. Crusher run base for non-highway pavement and drives shall be 8" of stone without the addition of cement.
 - 4. Binder base for secondary roads shall be a minimum of 6" HB binder conforming to specifications of the Department of Transportation.
 - 5. Concrete base shall consist of 8" of concrete, reinforced with #4 reinforcing steel bars placed at 8" on center in the transverse direction and #4 tie bars in the longitudinal direction. Concrete shall be designed to produce a compressive strength of 3000 psi at 28 days. The design of the mix and source of supply shall be subject to approval of the Engineer.
- E. Pavement shall be replaced with the same type of pavement that exists prior to cutting and shall consist of either bituminous surface course (double treatment), 2" of hot plant mix asphaltic concrete, or 8" of Portland Cement concrete; all conforming to specifications of the Department of Transportation for each type.
 - 1. All pavement shall be repaired within the same week that it is cut. Should inclement weather delay pavement replacement, the Contractor shall not cut additional pavement until he has notified the Engineer and received specific permission and instructions.
 - 2. For asphalt pavement or bituminous surfacing, the entire area to be resurfaced (including edges of existing pavement) shall be primed with an acceptable asphalt prime coat just prior to placing new pavement.

4.10 REPAIRS TO DAMAGED SERVICES AND UTILITIES:

- A. Repairs to damaged services and utilities shall be promptly made at the Contractor's expense. The Contractor shall use every effort to avoid damaging or breaking water, sewer, gas, power, telephone or other utility services. Utility lines shall be properly supported across the pipe trench until backfilling is completed. Should damage occur, immediate action shall be initiated to effect satisfactory repairs. All repair work shall be satisfactory to the Engineer and the Owner of the damaged utility.

4.11 DUST CONTROL:

- A. The Contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. The Contractor will not be directly compensated for any dust control measures necessary, as this work will be considered incidental to the work covered by the various contract items. The Contractor will provide dust control measures as directed by the Engineer.

4.12 MISCELLANEOUS ITEMS:

- A. The Contractor shall be responsible for removing and replacing miscellaneous items in conflict with the pipe work such as mail boxes, signs, fences, walls, shrubbery, private ornamental items, etc. Shrubby and plantings shall be preserved by proper root protection and watering until replanted; however, the Contractor will not be required to guarantee replanted items. No additional payment will be made for removing and replacing miscellaneous items.

PART 5 - TESTING AND CLEAN-UP

All pipelines shall be tested in accordance with the following requirements:

5.1 PRESSURE TESTING:

- A. Prior to pressure testing, the Contractor shall pig the line with a properly sized pig. The Contractor shall provide the necessary water for flushing the pig through the entire pipe length in order to remove debris and trash from the line.
- B. Each section of the pipeline shall be subjected to and successfully meet a pressure test of 150 psi. The line shall be slowly filled with water and all air expelled through the air valves or other means. A suitable test pump, furnished by the Contractor, shall be connected to the line by means of a tap in the line, or other suitable methods, and the proper test pressure slowly applied to the line. The pressure test shall be maintained for at least one hour, at full test pressure. Leaks, if found, shall be immediately repaired.
- C. After the pressure test is complete, a leakage test shall be conducted. Leakage test shall be conducted by measuring, by suitable and accurate methods (measuring devices to be furnished by the Contractor), the amount of water which enters the test section under maximum operating pressures for a period of at least two hours.

- D. No pressure pipe installation will be accepted until leakage is less than the number of gallons per hour for each section tested, as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

- L - Allowable leakage, in gals. per hour
N - Number of joints in the length of line under test
D - Nominal diameter of the pipe, in inches
P - Average test pressure, in psi

Should any test disclose leakage greater than that allowed above, the Contractor shall, at his own expense, locate and repair the defect until the leakage is within the specified allowance.

- E. Contractor shall furnish all necessary pipe or hose extensions or transportation to the point of use and shall exercise care in the use of water.

5.2 CLEAN-UP:

- A. All pipeline rights-of-way and pipework areas shall be cleaned up and left in satisfactory condition.
- B. Clean-up of work along highways or roads shall be performed immediately upon completion of the backfill operation. Pipe laying shall be stopped at any time that clean-up work lags and shall not be resumed until clean-up progress is satisfactory to the Engineer.
- C. Clean-up of work for cross country locations shall follow immediately upon completion of any major part of the work or upon instruction by the Engineer. Topsoil shall be replaced on all areas of disturbed by the pipeline work throughout the length of the water mains, and to the full satisfaction of the property owner. Topsoil may be removed from the line of work and stockpiled for future use. It shall be carefully removed, stockpiled, protected, respread, dressed off, and the entire right-of-way left in condition acceptable to the Engineer and property owner. If topsoil is not stockpiled and protected, suitable, approved material from other sources shall be provided. Where the line is located on pasture land, grassed areas, or roadway shoulders, grass shall be replaced.

PART 6 - GRASSING

- A. The disturbed pipeline area shall be seeded in accordance with Section 02480, Seeding and Mulching.

PART 7 - INSPECTION AND ACCEPTANCE

- 7.1 All work shall be subject to inspection and approval prior to final acceptance and payment. Final acceptance shall be contingent upon the following:
- 7.2 All pressure and leakage tests shall yield satisfactory results.
- 7.3 Final clean-up will meet the approval of the Engineer, the Owner, and property owners where applicable, with all defects in ditch settlement, pavement

patches or other deficiencies being promptly corrected.

END OF SECTION 02723